**Mobile App for the University**

Final Report for CS39440 Major Project

*Author*: Mark Lewis ([mal60@aber.ac.uk](mailto:mal60@aber.ac.uk))

*Supervisor*: Dr. Bernie Tiddeman (bpt@aber.ac.uk)

6th March 2016

Version 1.3 (Draft)

This report is submitted as partial fulfilment of a BSc degree in  
Computer Science (G401)

Department of Computer Science

Aberystwyth University

Aberystwyth

Ceredigion

SY23 3DB

Wales, UK

**Declaration of originality**

In signing below, I confirm that:

* This submission is my own work, except where clearly indicated.
* I understand that there are severe penalties for Unacceptable Academic Practice, which can lead to loss of marks or even the withholding of a degree.
* I have read the regulations on Unacceptable Academic Practice from the University’s Academic Quality and Records Office (AQRO) and the relevant sections of the current Student Handbook of the Department of Computer Science.
* In submitting this work I understand and agree to abide by the University’s regulations governing these issues.

Name …………………………………………

Date ……………………………………………

**Consent to share this work**

In signing below, I hereby agree to this dissertation being made available to other students and academic staff of the Aberystwyth Computer Science Department.

Name …………………………………………

Date ……………………………………………

**Acknowledgements**

I am grateful to…

I’d like to thank…

**Abstract**

Include an abstract for your project. This should be no more than 300 words.

**Contents**

Contents

[1. Background, Analysis & Process 7](#_Toc447825009)

[1.1. Background 7](#_Toc447825010)

[1.2. Analysis 8](#_Toc447825011)

[1.2.1. Deciding topics areas for the app 8](#_Toc447825012)

[1.2.2. Professional finish and feel 9](#_Toc447825013)

[1.2.3. Storage of data offline 10](#_Toc447825014)

[1.2.4. Longevity of the app 10](#_Toc447825015)

[1.2.5. App platform 11](#_Toc447825016)

[1.3. Process 12](#_Toc447825017)

[2. Design 12](#_Toc447825018)

[2.1. Overall Architecture 13](#_Toc447825019)

[2.1.1. Data Storage 14](#_Toc447825020)

[2.2. Detailed Design 15](#_Toc447825021)

[2.2.1. Class – AppData 15](#_Toc447825022)

[2.2.2. Class – MainMenu 16](#_Toc447825023)

[2.2.3. Classes Containing a Single Layout Resource 16](#_Toc447825024)

[2.2.4. Classes Containing Multiple Layout Resources - Accommodation 16](#_Toc447825025)

[2.2.5. Classes Containing Multiple Layout Resources – Getting Here 17](#_Toc447825026)

[2.2.6. Classes Containing Multiple Layout Resources – Undergraduate/Postgraduate Courses 18](#_Toc447825027)

[2.3. User Interface Design 19](#_Toc447825028)

[2.3.1. Menu Design 20](#_Toc447825029)

[2.3.2. Single Page topic areas 21](#_Toc447825030)

[2.3.3. Pages Containing Large Amounts of Content 21](#_Toc447825031)

[2.4. Jsoup 22](#_Toc447825032)

[3. Implementation 24](#_Toc447825033)

[3.1. Features 24](#_Toc447825034)

[3.1.1. Filling the App with Content 24](#_Toc447825035)

[3.1.2. Offline Storage of Data 25](#_Toc447825036)

[3.2. User Interface 26](#_Toc447825037)

[3.3. Jsoup 26](#_Toc447825038)

[4. Testing 27](#_Toc447825039)

[4.1. Overall Approach to Testing 27](#_Toc447825040)

[4.2. Automated Testing 27](#_Toc447825041)

[4.2.1. Unit Tests 27](#_Toc447825042)

[4.2.2. User Interface Testing 27](#_Toc447825043)

[4.2.3. Stress Testing 27](#_Toc447825044)

[4.2.4. Other Types of Testing 27](#_Toc447825045)

[4.3. Integration Testing 27](#_Toc447825046)

[4.4. User Testing 27](#_Toc447825047)

[5. Critical Evaluation ~2000 28](#_Toc447825048)

[6. Appendices 29](#_Toc447825049)

[A. Third-Party Code and Libraries 29](#_Toc447825050)

[B. Ethics Submission 30](#_Toc447825051)

[C. Code Samples 32](#_Toc447825052)

[D. Similar Apps used by other institutions 33](#_Toc447825053)

[Annotated Bibliography 34](#_Toc447825054)

# Background, Analysis & Process

## Background

Prior to starting this project I had no previous experience working with the Android SDK, therefore one of my first tasks was to familiarise myself with it. I began by visiting the site for android developers [1], where I was able to find tutorials on many aspects of android development as well as tips for new developers on getting started.

Although I had no previous experience of developing android applications, I chose this project, as it was an area of the course that I was keen to learn more about. I have studied Java during my undergraduate modules and when I learnt that android applications are written in Java, I thought android app development would be an area where I could develop the skills I initially gained from studying Java. I also like the design aspect of system development, and enjoy producing an interactive application at the end of the process.

The first tutorial I followed walks you through creating a basic app in Android Studio; the official IDE for Android. The tutorial includes setting up Android Studio, creating an application with a simple user interface and starting another activity. The tutorial guides you through the basic functions of Android Studio, and gives you a base from which you can start developing your own application.

This Android developer’s tutorial introduced me to the basic functions and structures of android, where I learnt how to add items such as buttons and textboxes using xml as well as how to link the layout xml files to java classes. Another lesson in the tutorial was to move between android activities, a core function needed when developing applications.

As this was my first time using Android Studio it gave me a chance to use the UI designer, a feature of the IDE which would be heavily used to design and implement layouts in my application. Creating layouts can be done using the device preview screen or programmatically using xml code. Initially I found the xml code confusing as it is something I have only briefly used previously, and so, I focused my attention on designing pages using the device preview screen.

There was a two week period between the start of the project and my first meeting with the Marketing Department, meaning there was a brief time where I had no specification or list of requirements for my application. I decided to use this time to conduct research into apps published by other higher education institutes in the United Kingdom.

I noticed that many universities had published apps, a large proportion of which were aimed at current students, with only a small number of universities also targeting potential students. This meant I only had a limited number of other apps available to provide me with an idea of suitable content, layout and functions which would be the most desirable in my own app.

I spent some time studying these apps in more detail, taking notes about the topics they covered, any libraries they were using and also the layout of content itself. All this information helped me build a picture of the type of data and layout I could potentially include in my app.

I also studied the webpages on the Aberystwyth University website to view the range of content which could be covered in the app. Many of the webpages had a natural flow between each pages content, I noted that the pages which were heavily advertised and promoted were the pages which would be most appropriate for the app, as this is the important or key information aimed at recruiting students.

I then combined the information from both sources, about competitor’s apps and the current content available on the University’s website, in order to start building a requirements list to present to the Marketing Department in our first meeting.

After my initial meeting with the Marketing Department I found that their ideas were very similar to what I had been working towards. They were keen to find out what their competitors were doing and if there was a general theme, they wanted to match it.

## Analysis

From the background research I learnt that many other institutes were using their prospective student apps in two ways; either to promote courses and student life at their University or to view publications such as magazines and prospectuses. From meetings with the Marketing Department I knew they wanted me to develop an app similar to the first style as they had been in talks with an external company to develop a separate system on which they could distribute publications.

### Deciding topics areas for the app

I knew my main task was to decide which topics I would address in the app. I was able to use the knowledge of competitor’s apps and an understanding of the available content on the University’s website gained during my background research, to start putting together some ideas.

Due to the University’s website containing a large amount of content aimed at prospective students, the number of topics and possible combinations available was similarly very large. This meant it was important not to over fill the app with too much content and instead select key information which would be the most informative and useful for the users of the app.

A final list of ten topics was decided to be covered in the app. Listed here;

* Undergraduate Courses
* Postgraduate Courses
* Scholarships and Funding
* Study Abroad
* Accommodation
* Open Days
* Virtual Open Days
* Getting Here

These topics were then grouped into three categories; Academic Information, Student Life and Open Days.

The list of topics was generated by comparing the content available on competitor’s apps with the information available from the Aberystwyth University website, to identify and understand the key areas of information. Once the list had been generated it was approved by the Marketing Department. This was an important aspect of the requirements gathering phase, as it meant the app would address the topics and provide the overall content that the customer wanted.

A full list of features used in other institutes apps can be found in appendix D.

There were other topic areas which could have been covered in the app that did not make the final list. One idea was to try and base the app around the University’s Online Virtual Open Day [2]. The Online Virtual Open Day gives potential students a taste of the University without having to physically travel to Aberystwyth. One feature of the Online Virtual Open Day which I looked at implementing in the app was the ability to chat with lecturers and support staff via an instant chat function.

I knew that the University used an instant messaging service called LibraryH3lp [3] which ran on the XMPP chat protocol. There was no API or support for building an Android App on their developer’s site so I set out to find a tutorial which I could follow to see if I could get a prototype working.

I found a tutorial on TutorialsFace [4] which I started to follow before the final list of requirements was decided. I did not manage to create a working prototype of the instant chat facility before it was ruled out as a feature of the App, but it did further my understanding of using Android Studio.

Another content area which was not included in the final design was information about the different service departments within the University. The University has several departments which offer support to students with non-academic issues such as Student Support, Information Services, Campus Services and many others. I had a discussion with the Marketing Department as to whether we should include content on these departments, as I thought it may be beneficial for educating users about other aspects of the University, but it was decided that it was not needed and would not be crucial information for recruiting students.

### Professional finish and feel

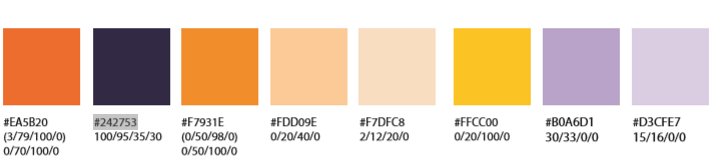
If the end product is of a high quality then it could be adopted by the Marketing Department and published on the App Store. This meant another aspect was to create an application that is professional enough to represent the University.

This means the app needs to have an appearance which is aesthetically pleasing as well as being efficient and easy to use. There are many interface design options available when creating an app; therefore it was important to select a style which could display the large amount of content in a readable manner, as the content will be displayed on a variety of devices with different screen sizes.

The interface also needs to be consistent throughout the app. This means pages which have a similar amount of content or structure need to use the same layout. This will help to give the app a more professional look as well as improving the user’s ability to navigate through the app.

When deciding on layout types it is important to choose styles which can be re-used and shared on pages with similar structures. If styles are picked which are too specific then the app could end up containing multiple layout types which will damage the consistency and appearance.

Another aspect of design which needs to be taken into consideration is the colour scheme. In order to look professional and represent the University the app needs to adopt the University’s colour scheme, for this reason the app implements yellow, navy and orange. The full list of colors I can use within the application are below.

An app is not of a high quality just because of its appearance, it also needs to behave as the user expects in order to fall into the category of a professional app. The final app needs to be robust and reliable, so not prone to crashing; this can be achieved by putting in methods to ensure proper error checking and handling.

### Storage of data offline

Another aspect of the app the Marketing Department were keen to see was being able to access the content at any time, making the app similar to a prospectus in your pocket which you could refer to wherever you are.

Therefore, the application (app) needs to download and save content for each activity of the app somewhere on the device and then be able to load content back in when needed. There are multiple options which can be chosen for this feature and this created a new task of choosing the option which would be most beneficial to the app.

The amount of data which is within the app is quite large and so storing it on the device was chosen to reduce the load time between activities as well as improving the likelihood of an individual using the app. If the user is going to have to switch on their mobile data to use the app it may discourage them from doing so, as data charges can be relatively expensive.

### Longevity of the app

In order for the app to be reusable each year it is important that there is some way in which the content on the app can be updated. If the app needs to be re-written each year to contain the latest information then it has been poorly developed. For example it would be a bad idea to hard code the content into the app on creation as it could not be updated at a later date without re-building the whole app.

This means another task was to find a way to keep the content of the app up-to-date. There are multiple ways in which this can be achieved: using a content management system is one option. The University already has a content management system for its website, if it is able to work with an Android application then it would be a suitable option; if not then one would have to be created specifically for the app.

An alternative is to find a way to scrape data from websites and use it within the app; this requires a small amount of research into Java libraries. If there is the possibility of using a library to do this then it would be extremely helpful as it would save time by not having to write my own methods to do so.

I discovered that the University’s content management system did not work with Android applications, ruling out the option of using it to populate the app with content. I then turned my attention to whether or not I could create my own content management system or find an alternative. I looked into other content management systems online and found none which were suitable for my project.

There was the possibility of creating my own content management system. It would need a web interface in order for the Marketing Department to input the content and a database to store the content which they had uploaded. The data could then be read straight from the database and into my Android application. One drawback to this method was that the topics which were going to be covered in the app already had content available on the University’s website. This meant that the data would simply be duplicated by copying it straight from the site into the content management system.

So, I looked for a way of extracting data from the website and using it within my application. I found a Java library called Jsoup [5] which is a HTML parser and it looked as if it was able to fit my needs. You are able to get content from a given URL or from inputting a file, something which I would need in order to edit the data if the device was online, and also to load content which had been saved for offline use.

Once a webpage is parsed as a document you are able to manipulate the data by selecting HTML attributes, elements and text. After the content you require has been selected you can then output it as either plain text or wrapped with its existing HTML code, this means it could be displayed in either Android text views or web views.

### App platform

Developing mobile apps for multiple operating systems can be done in different ways. One way is to build an app which is cross-platform compatible. This usually involves building the app in HTML and using a program which will wrap code around your app in order to display it on each different operating system. Another alternative is to develop the app so it is native to one operating system and repeat this process for each operating system you want to target.

In an ideal situation the app would be useable on all mobile operating systems. Therefore I looked into the possibility of using PhoneGap [5], a program which allows you to build cross-platform apps using HTML, CSS and JavaScript. I did some research into PhoneGap and found that it had mixed reviews online, an article on Roadfire Software’s [6] website debated the pros and cons of using PhoneGap versus developing a native app.

The article suggests there is a noticeable drop in overall performance and many user interface bugs to overcome when developing an application using PhoneGap. There is also some design issues due to mobile differences, for example android phones have a back button whereas iOS does not, and this is something that would have to be addressed when building the app.

Another reason why I decided to develop an app native to Android is because I had experience using Java and had already found several Java libraries which I intended to use. I felt I was more likely to produce an app of higher quality due to previous experience in developing Java than I would by starting from scratch with PhoneGap.

I also had a discussion with my Major Project Supervisor Bernie about which option may be the best. We decided that it was best to target a native Android App and if the finished product was good enough to be used then the Marketing Department could find another individual to build the app in iOS too.

A final factor which influenced choosing Android was its larger market share than any other mobile operating system available. According to IDC, at the second quarter of 2015 82.8% of mobile units shipped were Android devices [8]. This should result in the app having a larger target audience than choosing an alternative operating system.

## Process

The life cycle model I have used for this project is based around feature driven development as it seemed like a perfect fit for both this project and myself. An important aspect of feature driven develop is the features; gathering them and planning how you will implement them. Features are aspects of the system which are important to the customer, they are used to gather requirements and plan the design.

Initially there were no requirements set for this project and I had to meet with the Marketing Department in order to find what they wanted from the application. This helped me to work towards building a feature list and also developing an overall model of the system.

Once a feature list has been created you can then start the next phase of planning by feature. Traditionally in feature driven development you assign features as classes to programmers in your development team, as this is an individual project the ownership of all the features belongs to myself.

During the design by feature phase a design package is created for all features. The lead programmer meets with each programmer to create sequence diagrams for their features. Once all features have been assessed then the lead programmer selects a group of features to be developed over the coming iteration. These features are then developed and promoted to the main build after they have passed unit tests.

For my project this is the stage where I have decided to make an alteration to feature driven development. Instead of working in iterations I decided to work through my features in a progressive order. I tried to start off with features which were necessary in order for other features to be implemented. For example implementing the offline storage of content is a simpler task if you have already implemented the content, as you have a better understanding of how the content can be stored.

Feature driven development has a strong emphasis on project tracking. Features are split into milestones, there are six milestones per feature. This helps you to track the progress of the feature you are currently working on as well as the overall progress of the project. I felt this aspect of feature driven development allowed me to continue to be motivated during the project.

# Design

You should concentrate on the more important aspects of the design. It is essential that an overview is presented before going into detail. As well as describing the design adopted it must also explain what other designs were considered and why they were rejected.

The design should describe what you expected to do, and might also explain areas that you had to revise after some investigation.

Typically, for an object-oriented design, the discussion will focus on the choice of objects and classes and the allocation of methods to classes. The use made of reusable components should be described and their source referenced. Particularly important decisions concerning data structures usually affect the architecture of a system and so should be described here.

How much material you include on detailed design and implementation will depend very much on the nature of the project. It should not be padded out. Think about the significant aspects of your system. For example, describe the design of the user interface if it is a critical aspect of your system, or provide detail about methods and data structures that are not trivial. Do not spend time on long lists of trivial items and repetitive descriptions. If in doubt about what is appropriate, speak to your supervisor.

You should also identify any support tools that you used. You should discuss your choice of implementation tools - programming language, compilers, database management system, program development environment, etc.

Some example sub-sections may be as follows, but the specific sections are for you to define.

The first stage of design on a feature driven development project is to design by feature. As I already had a feature list and had chosen to work through the list sequentially, each feature’s design phase happened separately rather than as a group of features which were to be implemented over the coming iteration. This allowed the design to be much more dynamic as I was able to learn from mistakes made during the design of earlier feature’s and use similar designs for resembling features.

Implementing features one after another also meant that many of the original designs were no longer adopted. In most cases a design would be made which would allow the feature to be built into the application, then when it came to adding new features which relied on prior features, the old design would no longer be viable. This process meant it was important not to become too engrossed in creating concrete designs as they would likely change.

One aspect of design which could have been overlooked on this project was the user interface. There were no requirements set for the appearance of the app as the Marketing Department had given me full freedom to create a layout which I believed worked best for the task. For this reason it is easy to forget that the user interface is also a feature as it was not an aspect of the product that was stipulated by the customer.

Generally each feature is assigned its own class, depending on the complexity of the feature the amount of methods it contains will vary. Some features are considered as activities in an android system, this means the user is able to interact with them and as a result they require their own layout file. Where activities are very much alike it is possible to re-use layout files in order to save time and space, but there may be special occasions where similar activities require different layouts.

## Overall Architecture

Each mobile app will have some form of home screen, depending on the apps function this may be used once or multiple times. I knew that my app would have multiple pages displaying content and would therefore require a main screen which could be used to link all of the pages together.

From the menu page there needs to be a way to access the detailed content on the ten topic areas which have been selected during the requirements gathering process. Each topic area will have its own page within the app, while some topics may require multiple pages; this is something which will be discussed further in the detailed design section of this document.

Before the user can view the content on the application it must first be downloaded and stored on the device, to do this I planned to implement a splash screen as they are commonly used in applications and games whilst they load. I felt that if executed correctly, the splash screen would give the app a professional feel and finish. Alternatively the app could have loaded the menu screen immediately, but the user would be unable to view any content as it would not have been saved on the device yet.

When the app is launched it should first check if there is data saved on the device. If there is no data downloaded on the device, if then the device must be online in order to fetch content. Depending on the result of these checks different methods need to run; download content, proceed to menu or display error for no internet connection.

Once the data has been successfully downloaded the user may proceed to the menu screen, where they are able to view the subject areas within the app. The design of the user interface can be make or break for a mobile application, in the user interface design section of this document I will outline the decisions I made in terms of design as well as justification for the mentioned decisions.

On selecting a content area from the menu the user should be taken to a section about that topic. Depending on the topic the section may be a singular page within the app, or it may contain its own menu where the user can select to view more specific data. For example the undergraduate and postgraduate courses are likely to broken down into departments and individual course.

### Data Storage

The data used to populate the pages within the app needs to be stored within a data structure. There are five possible storage options listed on the Android Developer’s website [9], I used this information in order to choose the storage method which I felt was most appropriate for the amount of files which would need storing.

Two of the options were easily dismissed straight away; shared preferences and network connection. Shared preferences is generally used to store user choices such as ringtones which are stored as objects on the device. These objects can then be loaded into the app to set it up to the users liking. As the data which needs to be stored on the phone is consistent across all user’s instances of the app this storage method would not be required.

Network connection involves the device being online in order to connect to a web-based service to store and load the data. Due to the requirement for offline storage within this app, network connection was removed as a potential option.

That left three conceivable routes; the first was a SQLite database on the device which is private to the application. A SQLite database would be useful if the app required large amounts of normalised data, however the data needed could be stored as string values and would not desire a complex data structure.

Therefore I was left to choose between storing the data on the devices internal or external storage. Ultimately I chose to use the phones internal storage instead of any external storage such as SD cards the device may have. One reason for choosing internal storage is because not all devices have external storage, and users don’t always use external storage even if their device supports it. Secondly the data that needs to be stored should not be too large in capacity and should be able to be stored on the device. The final feature was that data stored internally is only accessible by the app which creates it, unlike data stored externally which is available to any person or app. This was not a major factor when choosing between the two storage options as the data stored is not sensitive, but it does stop the user changing or deleting files which may cause the application to become unstable.

## Detailed Design

This section contains added detail on the application’s design, where appropriate classes will be discussed individually, but in some cases classes were very similar and therefore do not require individual deliberation.

### Class – AppData

This is the first class to run when the application is launched; the plan for this class is to download data onto the device. An initial check needs to be done in order to test the internet connection on the device; from there the data can be downloaded.

To stop data being downloaded each time the app is launched and connected to the internet a further check needs to be done; regardless of whether there is data already on the device. This check can be combined with the check for internet connection as both will return a Boolean answer. There are three potential answer combinations which will require action; data downloaded true, internet connection true and downloaded data false, finally internet connection false and data downloaded false. We can ignore the status of the internet connection at all times when data downloaded equals true, as the device does not need to be online to download data if it already exists.

This can be one method which is run in AppData’s onCreate after the layout file has been linked and any elements initiated.

If there is no data downloaded as well as no internet connection then an error message will be displayed. There is no method required to do this, as a single line of code can produce a message on the screen to tell the user to enable a connection.

When there is no data downloaded but the device is connected to the internet the class should run a method to download content. This is likely to be the most complex method within the application as it needs to connect to each page, manipulate the data and finally save it on the device. As this method is going to use the device’s network it must be run as part of a thread or AsyncTask.

This method will retrieve each page of the apps content and save it as a separate file for the corresponding page. These methods will require a URL for the webpage they need to connect to, then using methods from the Jsoup library, content can be selected in order to be saved.

I would like each method to download only the content required for the app in order to minimise the amount of storage the application will use. This should also speed up the process of loading data into the app as there will not be any data manipulation executed as pages are loaded.

Each method for generating the applications content will need to save the data. For each method whose output is in the same format they can make use of the same save method. This method will require an input variable in order to name the files.

If the content is outputted in different formats then multiple save methods may be required. For example a different save method for saving strings and saving arrays.

### Class – MainMenu

This class runs the code behind the menu’s user interface. Regardless of the layout of the final menu screen this class has one main function, to provide navigation to the applications content. Methods will be required for each page the menu links to, these will be called when items or buttons are selected in order to start the next activity.

From the menu screen I also wanted the user to be able to re-download the apps content. This means that if the University webpages that were used to generate the content get updated, then users are still able to download the latest content onto their phone. This method could also be used if there is any corruption of data within the app, by replacing the current corrupted content.

In order to download the latest data, the files which are currently on the device must first be deleted. After the files have been deleted there needs to be a way in which the app can download the new content. To do this another method could be implemented within the menu class. But at its current state the app is the same as if it has just been installed on the device, therefore we can re-use the code which runs on start up within the AppData class to also generate content. This means instead of creating a new method an intent can be called to start the AppData class again.

The final method used within this app is to override Android’s handling of pressing the back button. Ordinarily if the back button is pressed then the app will move to the current activity’s parent activity (which is declared in the Android Manifesto) if there is no parent activity then it will rewind to the last used activity. As the menu is the applications main page there is no need for a parent activity and also no need to move back to the splash screen, for these reasons the back button can be disabled.

### Classes Containing a Single Layout Resource

Within the application five of the topic areas only require one page to display their content; Study Abroad, Students’ Union, Sports & Societies, Open Days and Virtual Open Days. This means these five classes all share similar structure and methods to avoid repetition of descriptions they have been categorised together.

Present in all activities within an Android application is an onCreate method and these five activities are no different. The onCreate method sets the activity’s layout by linking the appropriate XML file and initialising any interactive elements. Next the content needs to be loaded onto the screen, to do this the data must first be loaded from a file into a class variable, this requires a separate method. There will also need to be some error handling when calling the loading method in the event of a ‘file not found’ exception.

The method to load the content from a file is the same for these five classes, it can also be re-used in other classes in the application where the data is to be loaded in as a string. In order to load the file, the method will require the targeted filename as an input, this could either be taken as a variable as it is run or coded into each class’s version of the app.

### Classes Containing Multiple Layout Resources - Accommodation

The remaining five topic areas all have a larger amount of content and therefore are unable to be displayed on a single page, resulting in each topic area requiring multiple classes.

The first topic area is for Accommodation. An appropriate design for this section would be to first have a list of available accommodation which when clicked, directs the user to a page with details about the selected accommodation block.

For each specific accommodation block on the University Accommodation website [10] there are up to eight sections of content. Displaying all eight sections would potentially be too much content to view within a small mobile device and therefore I decided to reduce the number of sections included. I chose to exclude the following sections; What’s in your shared access, Location, Gallery and Tour. There were multiple reasons for not including these sections, for example the location and tour sections included map walkthroughs and were going past the level of detail required in the app. This left me with the following core sections; Overview, Facilities & Services, What’s in your room and Fees.

The first class I would require would be for the list of accommodation. This class needs a list of accommodation blocks, as well as the content for each block; these can be stored as arrays. It is possible to re-use the load from file method which is also present in the five classes containing single layout resources.

The list of accommodation blocks needs to be clickable so a second method is needed to handle the items being clicked. This method must start the accommodation detail activity, passing it the correct content for the chosen accommodation block. This can be done by putting the accommodation block’s content in to an intent and then starting the activity.

A second class is required to display the content specific to each accommodation block. This class will be in control of receiving the pages content, splitting it up into each section and arranging it. The data which has been sent from the intent in the first class will need to be stored as a class variable for use later on; there is no need for a separate method to do this.

There will be a method required in order to separate the received data into the four prescribed sections. This method will make use of Jsoup library functions, parsing string data into a document, selecting the needed content and finally returning four separate outputs. These outputs can be displayed immediately as part of the method, though it is a better idea to store them as class variables and then assign them to android views; this should hopefully reduce data loss when switching between sections.

The exact layout of the accommodation details will be discussed further in the user interface design section of this document. Depending on the chosen layout style there may well be need for a class for each of the four sections.

### Classes Containing Multiple Layout Resources – Getting Here

This class’ task is to provide users with information on how to get to Aberystwyth and its University campuses. The four webpages which this section of the application are generated from contain information on travelling to Aberystwyth University via car, bus, train and from further afield.

Unlike most pages on the University website there was a lack of consistency in the layout of content within the webpages, this meant code would not be re-usable in order to generate content from these pages. I also felt that the content for getting to Aberystwyth via bus was too precise as it was limited to the buses within Aberystwyth and then linked to the local bus company’s site. Additionally I felt the content for traveling from other countries was irrelevant as it gave users a list of airports and directed them to the nearest train station with a link to National Rail’s website to check train times; which they would likely have already done themselves.

This left me with two remaining sections; car and train. The section on travelling by car appeared relevant and it gave postcodes for each campus within Aberystwyth, it also mentions the noticeable road signage to look out for while en route. The train content is a little vague but nevertheless it is a popular method of travelling to Aberystwyth and should be included.

The class would not require great amounts of complexity its main operation will be to load the data for each section into class variables and display them within a view. Therefore this class will only need the default onCreate activity and the load from file method which has been used throughout the other classes within the application.

### Classes Containing Multiple Layout Resources – Undergraduate/Postgraduate Courses

I have grouped together the final two classes as they both have the same structure, the only variant between the two is the area of webpage they generate content from. These classes will list the courses available to prospective undergraduate and postgraduate students.

On the website where the application’s content originates, the courses are listed first by department, then once a department has been selected a full list of courses for that department is shown. I plan to adopt the same structure within my app as I think it provides a simple way to find courses within the user’s subject of choice. The way the website differentiates between undergraduate and postgraduate courses is by using tabs which can be selected to change the list. When the tab is selected a different div element is shown on screen, I will need to make use of these separate div elements when fetching the data using Jsoup.

The first class required is for retrieving a list of departments. In order to display the departments as a list, each department will need to be selected individually and placed in an array. To do this the div containing the list of department needs to be selected, then all the links *(<a> tags*) can be selected; this will output the link’s text as well as any attributes it may be storing. Therefore, for each link selected, the corresponding text must be stored in an array and the links destination must be stored in a second array in order to find the next page in sequence. This process could be done when the app is first started and all the content is downloaded.

The first task for the class is to load in the lists and display departments on screen. If the data has already been stored in arrays then a new load from file method will need to be used as we are no longer loading in a string of data. Again, like other classes, a check needs to be run on the loaded data to catch any exceptions. Once successfully loaded the list can be displayed on the screen within an Android list view. This is probably the most appropriate view to display the content in as the layout of the list will be neatly displayed and the list view will also be clickable.

This leads on to the final method required in the first class, selecting a department. When a department is clicked it should then move on to the next screen; which will display a list of all courses provided by that department. To do this a method will be needed which finds the position of the department in the list and passes that position onto the next class, this can all be done using an intent much like in the accommodation class.

A second class is now required for displaying all courses within a chosen department. This class will need to receive information about which department has been selected, this should be done during the class’ onCreate method.

Now the class knows which department has been selected it must load in a file containing a list of courses corresponding to the correct department. It is likely that the list of courses will be generated in a similar manner to the list of departments, resulting in the courses being stored as an array. This means that the method used to load in the departments can also be used to load in the list. The list will be displayed using a list view in order to keep consistency and familiarity within the code.

Finally this class will require a method that can handle items in the list being selected. This method will be roughly similar to the one used when selecting a department.

The final class needed to view course information will be used to display material on a single course. Similar to the two classes previous this class will need to know which course it should be showing, this once more will be received from the intent sent from the preceding class.

Once the course is known, the class can then load in the corresponding file. The content is expected to be saved in string form and so the method used to load in the data will be the same as the load method most commonly used throughout the application.

The data from which the content for each course derives from seems to have an inconsistent number of sections depending on which course is selected. For this reason the most common sections will be displayed within the app, rather than each section available. By doing this I hope to avoid some courses looking sparsely populated compared to others as well as maintaining uniform content throughout. There appears to be five regular sections used in a large proportion of the course’s webpages; Course Overview, Course Content, Course Teaching, Employability and Student Views, and I plan to implement all five sections within the app.

## User Interface Design

Now that the topic areas have been selected and the content for each topic decided, decisions need to be made in regards to the user interface. For some sections of the app the interface will be simple and intuitive, for instances where topics only have one page of content. But for others there is the task of cleanly and effectively displaying large amounts of data in a way that is easily readable and navigable.

As the application is being developed for the Marketing Department and could potentially be representing Aberystwyth University it is vital that the application matches the house style adopted by the University. I sort out some information relating to the house style adopted by the University and received a copy of The University Brand Manual [11] from the Marketing Department. The document contains vast amounts of information which I would need to understand in order to match the house style.

There are details on using the Aberystwyth University logo and crest and a minimum size restriction which I could not exceed. The document also contained the hex values for colours in the colour scheme; these were useful as I could set the colours as defaults within my applications colour xml file. As the document was produced in 2013 I did have to get an updated version of some of the colours hex values from the Design and Print Department within the University.

Each activity within the application needs to have an xml layout file in order for the activity to be displayed on screen. For some activities the content would be similar and therefore the layout file could be shared. This will improve the consistency in the application’s layout and should give the user confidence that they understand how to navigate the app. The same principles should be adopted when using elements within a layout, such as buttons and list views, again to maintain consistency.

One design feature I knew I wanted across all pages of the app was a toolbar containing the page’s title. The toolbar would be best suited to using the dark navy colour with white text, as using navy as the background colour for each layout would result in an excessively dark screen. For certain pages the title can be hardcoded, but there will be pages where the title is unknown and must be set during runtime, for example when viewing specific course details.

The sections below contain more detail on individual aspects of the application. For some of the sections I have included mock up designs created using a free online user interface design tool called Fluid UI [12].

### Menu Design

As previously mentioned the menu screen plays an important role in the application by tying together all the content, thus the design of the menu needs to be easy to use and suitable for the style of the app.

One of my first ideas was to use a library for the menu page, I looked at a few options online at Android Arsenal [12] as I thought I was more likely to get a professional looking menu screen using a third party library. I found a few libraries which were based around Androids navigation drawer, where a menu bar appears when the user swipes across the screen or selects the menu button in the upper left of the screen. This menu style is commonly used within Android applications and it became a front runner from the start. There were also libraries featuring tiled views, where the screen is split up into rows and columns, with each field of the table linking to content.

Initially it was hard to choose a design for the menu as I was unsure how the content would all come together. So I started working towards implementing a navigation drawer as it seemed to be the most logical route to take and I needed a menu to start linking in other activities within the app. I found a tutorial on Code Theory’s website [13] which I used alongside the navigation drawers developers page on the Android site in order to create the menu.

Within a navigation drawer menu there are two aspects which need to be created; firstly the menu which swipes in and out, and also the main screen fragment. I decided to fill the main screen with introductory content taken from the Prospective Students welcome page as the content was relevant to this section of the app.

The navigation bar by default is laid out with an image at the top, followed by the menu items listed below. This layout suited what I wanted from the menu as it would allow me to place the Aberystwyth University logo at the top adding a brand to the app. The menu items can also be grouped together and given headings in order to place related topics together, I planned to make use of this feature as I had already grouped my topic areas together during the requirements gathering stage.

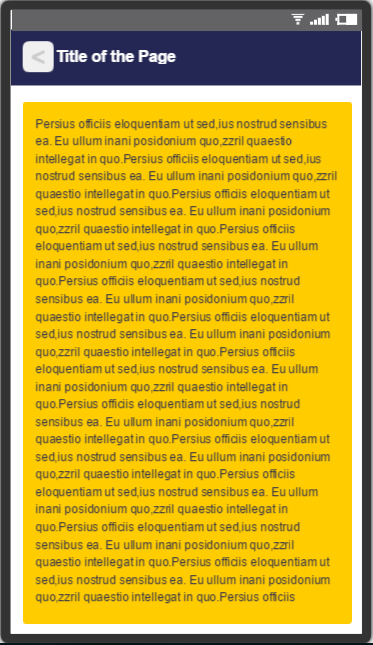
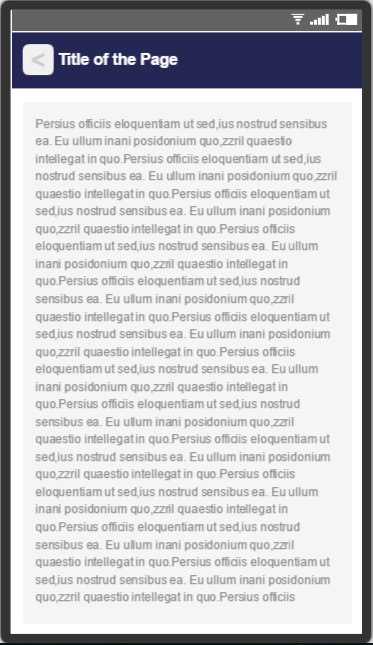
Another possible customisation to the navigation drawer is to change its background and text colours. This will allow me to adopt the University branding by changing the background colour to the bright yellow, as used on University publications and the text and toolbar to the secondary navy colour.

### Single Page topic areas

As previously mentioned, there are five topics within the app that can display their content on a single page. It is highly likely that the topics will all share the same layout file and so the design of all five can be discussed as one.

The first feature of these designs is the toolbar which will be present throughout the app, containing the activity’s title as well as a navigation button. By including a navigation button I hope to make it easier for users to move through the application’s pages on larger devices when the default back button may be away from the natural hand position.

The next area of the design to focus on is the area for displaying content. Depending on how the data is stored an Android text view or web view will be used to present the content. There are two options for the colour scheme here; yellow background with navy text or white background with black text. Below are two previews of the potential designs.



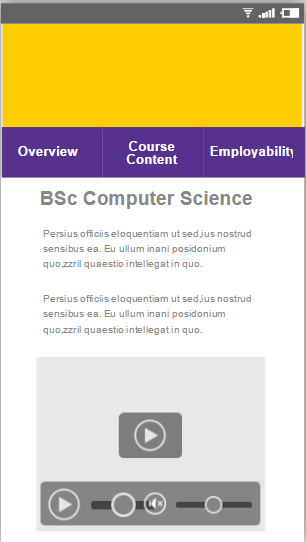
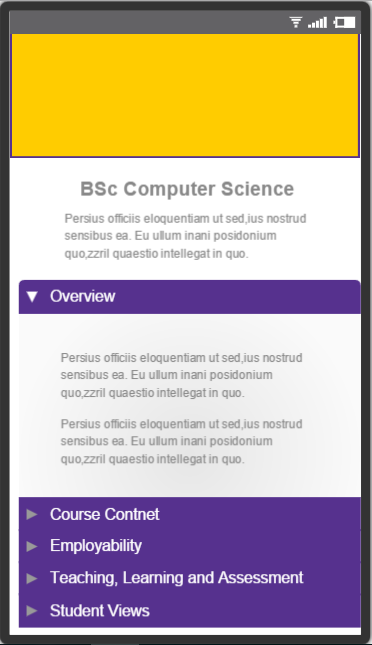
My main concern on having the background colour as yellow for the whole screen is that it may look too garish, therefore I decided to use the white background design as a backup just in case the colourful yellow option is too overwhelming when implemented on the device.

### Pages Containing Large Amounts of Content

One of the major design issues for mobile app development is displaying large amounts of content on a small screen. However it is likely that the app will be displayed on an array of devices with varying screen sizes, so this also needs to be taken into consideration. Within my application there are a few activities that contain multiple sections of content, for these activities I will need to implement a layout which will smoothly manage the transition between sections without overcrowding the screen.

I wanted to pick a design which could be applied to all topics within the app consisting of multiple content sections in order to provide clean and consistent finish. One way to do this was to have a separate page and layout for each section, though this idea seemed clunky and would involve too much exploration by the user to find content. By dismissing this first idea I knew that I would like to display all the sections within one page.

I created two possible designs, one using drop down sections and the other using a tab bar along the top of the page. The designs are shown below and were created using Fluid UI and modelled around displaying course details; they helped give me a feel for how they would look if implemented within the app.



I preferred the appearance of the tabbed design, as it allowed each section to have an equal amount of screen available. Whereas in the drop down design the sections looked as if they were getting in each other’s way and taking up valuable space on the screen.

## Jsoup

To generate content for the app I planned to use the Jsoup library. In order to re-use the app each year it would need to be updateable with the latest content, this meant that I would have to carefully select content in a way which would give the app the longest lifespan.

Jsoup is able to parse html from a given URL as well as from a document loaded in as a string. This means that a webpage can be manipulated and content generated at two separate stages in the applications lifecycle. I had the choice of whether to generate the content when the app is first launched and connected to the internet or when each page is displayed.

Downloading data to be stored on the device will take time and require the user to wait until the process has run. This would be an ideal point at which to generate the app’s content as it will reduce load time when manipulating content before it is displayed and would also reduce the time taken to save the content as it would only be the essential content being saved; not whole webpages.

A disadvantage to setting up the content on the apps original start up is that some data may be missed if the structure of the webpage was to change. By saving the webpage used to generate content the likelihood that targeted content will be missed is reduced. But the downside to this method is an increase in the size of files being stored on the device.

Another factor which will influence the time taken to generate content is the complexity of manipulation needed to scrape off relevant text from the webpage. For some topic areas the whole of the webpage’s body will be relevant, resulting in a simpler generating method. For others specific elements of the HTML will need to be selected and then operations performed on them to gather the required content. For these cases it may be best to create the data during the longer downloading method on start up.

There is potential for Jsoup to fail in its task of populating the app with content. If there is a major change to the structure of the University’s webpages and div ids are changed then the implemented methods will return null data. Another occasion when there may be null data present, is if the webpages specified for each topic area either change or are deleted; if this happens the app will not be able to connect to the site in order to generate any data.

Unfortunately, if any of the above does occur then there is little that can be done. I can put in place error checks to inform the user or there may be a way to revert back to the last working version of the application. But what Jsoup does offer is an easy way to maintain the app as the content is automatically generated. This means that if the Marketing Department update content on topic’s webpages then the changes should be naturally mirrored within the app. Using Jsoup means there will only be one content base, rather than multiple like if a content management system was used. This means that the application will be simpler for the Marketing Department to maintain in the future.

# Implementation

The implementation should look at any issues you encountered as you tried to implement your design. During the work, you might have found that elements of your design were unnecessary or overly complex; perhaps third party libraries were available that simplified some of the functions that you intended to implement. If things were easier in some areas, then how did you adapt your project to take account of your findings?

It is more likely that things were more complex than you first thought. In particular, were there any problems or difficulties that you found during implementation that you had to address? Did such problems simply delay you or were they more significant?

You can conclude this section by reviewing the end of the implementation stage against the planned requirements.

During the implementation phase I adhered to the methodology I had planned to use throughout the project. During this stage I worked towards adding each feature to the final build one at a time, I believe this helped me to develop a better understanding of the application and the relationships between each feature.

The methodology forced me at times to change my designs as I learnt of better ways to implement my plans and also encountered problems which could not be addressed by my original designs. I think this was important as changing my designs and having a dynamic approach allowed me to practise many aspects of feature driven development as well as agile software development.

One principle of agile methodology which I personally think is important is to regularly produce working software, I believe it gives you an indication of how much the project has progressed and also provides motivation as you can see the result of your work. By working through the feature list the application slowly comes together and you can produce working software both at the end of each completed feature and also as smaller tasks which make up a feature are finished.

I wanted to include functional content within the app as soon as possible and I worked towards including pages for topic areas before I created a comprehensive user interface. My thoughts were that the user interface side of the app could be fine-tuned once all the content was incorporated so I first created a menu screen based around the navigation drawer in order to add and test content.

## Features

Within this section I will highlight any classes which may be off interest, due to changes from the original designs or because of the implementation of methods which are key to the application. I will try to describe features in the chronological order to which they were implemented with the aim of showing the way in which my methodology effected how the application came together.

### Filling the App with Content

After a basic menu had been created I started working towards developing my list of topics. I started working on implementing the undergraduate course section of the app, as most of the code would be re-usable for the postgraduate course section with the addition of minor changes. This section would also be one of the largest and so I wanted to tackle it first.

I noticed that even though I was using feature driven development to include each feature within the application one at a time I could also break up features into more manageable tasks. For example this feature was broken down into each topic, I could then work through each topic one at a time until they were all implemented. Some topics took up a larger percentage of time than others, due to having a more complex class structure. But I found that as I became more familiar with the proposed layout types and using Jsoup that the last few topic areas were added to the build much quicker.

As I was developing by feature I just wanted to get the content working in the app without worrying too much about the other features, as a result of this as I added new topic areas the device had to be online. The application worked this way initially as I was connecting directly to the University website in order to quickly show the results of the methods I had written to scrape data from the web. Once I had the correct output for each topic area I could then focus on other features of the application such as offline use.

For the topic areas whose content was able to be displayed on a single page I was unsure when designing the classes whether to use text or web views in order to display the information. When it came to creating the pages I found that Jsoup has two functions which could be used to generate content; one outputs just the text from selected elements, the other includes the html code it is contained within. I chose to keep the outer html on the data and load it in to a web view. The web view would offer assistance with laying out the content as well as keeping original text styles such as headings within the view. Another advantage to using a web view to display content was its ability to contain links, as some content such as the Students Union’s page contained links to external sites. This means if a user of the application wants to find out more they are able to follow the links which will be opened within their browser.

Generating the content needed to be done off the main UI thread, therefore I had to use an AsyncTask class within the topics main class. An AsyncTask has three main methods which are run at different stages; pre-execute, on execute (called do in background) and post execute. I used the do in background method to parse in the webpage, manipulate the data and store it as a class variable. The variable could then be passed to the post execute method and used to display the content on the screen.

I didn’t encounter any major problems using Jsoup’s functions to display content within the app. There were occasions when the data I received wasn’t the same as the data I had expected and had to debug the code. The most common issue was when selecting text, Jsoup has a select function and will select all the chosen elements within either a page or highlighted section. I found that text which was a heading or had been given emphasis on a website was missed due to it not being contained within a p tag. An alternative route was to select everything within the highlighted section, but often this would lead to content which was not necessary. Fortunately there is a Jsoup method which will find and remove all given elements from the output, this was used to combat the problem.

### Offline Storage of Data

The app was now filled with content when the device was online, allowing me to move on to the next feature; using the application offline. In my design I had planned to have a class which was responsible for connecting to the required webpages, selecting content and saving it on the device. Before this class was created I first wanted to get a working save and load function and check that this was working as expected when the device was offline. So I decided to test some methods on a small section of content on the menu page.

I found methods for both reading and writing strings to and from a file from an answer by a user called R9J on a stack overflow question [15]. These methods were used initially to get the offline storage to work for the content on the home screen and also used later on to store all content in the application. The only change made from the original methods was to set the file name for each topic area, I have provided the two methods in Appendix C of the Appendices.

After getting the load and save methods working I started to implement a check which ran on the apps start-up; was the device online? And did the device need to download data? As there wasn’t yet a method for downloading all the apps content I could only check whether the test page had been downloaded. There was also no splash screen yet so I used toasts to pop up on the screen to display the outcome of the checks. I found a method on stack overflow [16] from a user call Tim which checks whether the device is online, I combined the method with one of my own which checked if a file existed. The original method uses a Connectivity Manager which means you need to allow the app permission to view the network state of the device, this is declared in the Android Manifesto for the project. The final method is listed in Appendix C of the Appendices.

I could then start work on the new class, AppData, which was responsible for downloading the app’s content. I worked through each topic individually, refactoring code used in the topics class to generate content over to a new method within the AppData class. I also had to give each topic area the load method in order to store the pages content within a class variable.

Once each topic had been set up to store content on the device I was able to move across the method which checks the status of the devices internet connection and downloaded data. In order to check whether there was any content on the device the method would need to check whether a file exists. The first time I copied the method across I set it to check whether the first topic area from the download method was on the device. Later I changed this to the last topic area, in case there was a problem downloading after the first file had been created. It was changed again to a file which would be generated once all topic areas had been successfully downloaded, eliminating the likelihood of the checks if there was missing content.



To complete the class I needed to add a layout file, this would be the apps splash screen. The splash screen is a full screen layout, with the Aberystwyth University logo and app title. There is also a text view placed at the bottom of the screen, the text displayed will vary on the status of the application and device. If there is no internet connection then a message is displayed telling the user to enable a connection and restart the app, if there is a connection but not data downloaded then it will inform the user that it is downloading data. If there is already data on the device then the app will move straight onto the menu activity.

The biggest change that occurred when implementing this feature involved how the content was stored on the device. I had planned to have multiple save and load methods depending on whether the content was to be stored as a string or an array. When it came to implementing the offline storage of data I realised that it would be much easier to store all topic areas as strings, then manipulate the content as needed within each class.

One area of this feature that I had underestimated was gathering data for all courses on the University website. When the application worked only when the device was online it could be done by storing one array containing the course title and another with the URL to the corresponding course. When a course was selected it would send the appropriate URL in an intent to the next class, the content detail class could then use the URL to connect to the correct webpage.

I had to create multiple methods within the AppData class in order to download the webpage for all courses. Using Jsoup functionality the first method creates an array containing the URLs of each departments list of courses before calling the next method. The second method loops through each departments list of courses, selecting the URL linking to the detailed webpage for each course and storing these in another array. A final method is called which save all pages in the second array to a file, naming them based on the URL.

## User Interface

## Jsoup

# Testing

Detailed descriptions of every test case are definitely not what is required here. What is important is to show that you adopted a sensible strategy that was, in principle, capable of testing the system adequately even if you did not have the time to test the system fully.

Have you tested your system on ’real users’? For example, if your system is supposed to solve a problem for a business, then it would be appropriate to present your approach to involve the users in the testing process and to record the results that you obtained. Depending on the level of detail, it is likely that you would put any detailed results in an appendix.

The following sections indicate some areas you might include. Other sections may be more appropriate to your project.

## Overall Approach to Testing

## Automated Testing

### Unit Tests

### User Interface Testing

### Stress Testing

### Other Types of Testing

## Integration Testing

## User Testing

# Critical Evaluation ~2000

Examiners expect to find in your dissertation a section addressing such questions as:

* Were the requirements correctly identified?
* Were the design decisions correct?
* Could a more suitable set of tools have been chosen?
* How well did the software meet the needs of those who were expecting to use it?
* How well were any other project aims achieved?
* If you were starting again, what would you do differently?

Such material is regarded as an important part of the dissertation; it should demonstrate that you are capable not only of carrying out a piece of work but also of thinking critically about how you did it and how you might have done it better. This is seen as an important part of an honours degree.

There will be good things and room for improvement with any project. As you write this section, identify and discuss the parts of the work that went well and also consider ways in which the work could be improved.

Review the discussion on the Evaluation section from the lectures. A recording is available on Blackboard.

# Appendices

* 1. Third-Party Code and Libraries

If you have made use of any third party code or software libraries, i.e. any code that you have not designed and written yourself, then you must include this appendix.

As has been said in lectures, it is acceptable and likely that you will make use of third-party code and software libraries. The key requirement is that we understand what your original work is and what work is based on that of other people.

Therefore, you need to clearly state what you have used and where the original material can be found. Also, if you have made any changes to the original versions, you must explain what you have changed.

As an example, you might include a definition such as:

**Apache POI library** – The project has been used to read and write Microsoft Excel files (XLS) as part of the interaction with the client’s existing system for processing data. Version 3.10-FINAL was used. The library is open source and it is available from the Apache Software Foundation [5]. The library is released using the Apache License [6]. This library was used without modification.

* 1. Ethics Submission

**Ethics Application Number: 4121**

AU Status

Undergraduate or PG Taught

Your aber.ac.uk email address mal60@aber.ac.uk

Full Name

Mark Lewis

Please enter the name of the person responsible for reviewing your assessment. Reyer Zwiggelaar

Please enter the aber.ac.uk email address of the person responsible for reviewing your application rrz@aber.ac.uk

Supervisor or Institute Director of Research Department cs

Module code (Only enter if you have been asked to do so)

CS39440

Proposed Study Title

MMP Mobile Application for the University- Android app for prospective students, made for the university's marketing department

Proposed Start Date 30/1/16

Proposed Completion Date 4/5/16

Are you conducting a quantitative or qualitative research project? Mixed Methods

Does your research require external ethical approval under the Health Research Authority?

No

Does your research involve animals?

No

Are you completing this form for your own research? Yes

Does your research involve human participants?

No

Institute

IMPACS

Please provide a brief summary of your project (150 word max)

Creating an android app for the university's marketing department. The app is aimed at prospective students and informs them on life and study at Aberystwyth University

Where appropriate, do you have consent for the publication, reproduction or use of any unpublished material?

Not applicable

Will appropriate measures be put in place for the secure and confidential storage of data?

Yes

Does the research pose more than minimal and predictable risk to the researcher?

Not applicable

Will you be travelling, as a foreign national, in to any areas that the UK Foreign and Commonwealth Office advise against travel to?

No

Please include any further relevant information for this section here:

If you are to be working alone with vulnerable people or children, you may need a DBS (CRB) check. Tick to confirm that you will ensure you comply with this requirement should you identify that you require one.

Yes

Declaration: Please tick to confirm that you have completed this form to the best of your knowledge and that you will inform your department should the proposal significantly change. Yes

Please include any further relevant information for this section here:

* 1. Code Samples

**Read string from file**

private String readFromFile() {

String ret = "";

try {

InputStream inputStream = openFileInput("filename");

if (inputStream != null) {

InputStreamReader inputStreamReader = new InputStreamReader(inputStream);

BufferedReader bufferedReader = new BufferedReader(inputStreamReader);

String receiveString = "";

StringBuilder stringBuilder = new StringBuilder();

while ((receiveString = bufferedReader.readLine()) != null) {

stringBuilder.append(receiveString);

}

inputStream.close();

ret = stringBuilder.toString();

}

} catch (FileNotFoundException e) {

Log.e("login activity", "File not found: " + e.toString());

} catch (IOException e) {

Log.e("login activity", "Can not read file: " + e.toString());

}

return ret;

}

**Write to file**

private void writeToFile(String result, String title) throws FileNotFoundException {

File file = new File(title + ".html");

FileOutputStream fos = openFileOutput(String.valueOf(file), MODE\_PRIVATE);

PrintWriter pw = new PrintWriter(new BufferedWriter(

new OutputStreamWriter(fos)));

pw.print(result);

pw.close();

}

}

**Check whether the device is online and whether it has data downloaded on it**

public void checkStatus() {

ConnectivityManager connec = (ConnectivityManager) getSystemService(Context.CONNECTIVITY\_SERVICE);

if (this.hasDataDownloaded() == false && connec != null && (

(connec.getNetworkInfo(ConnectivityManager.TYPE\_WIFI).getState() == NetworkInfo.State.DISCONNECTED) ||

(connec.getNetworkInfo(ConnectivityManager.TYPE\_MOBILE).getState() == NetworkInfo.State.DISCONNECTED))) {

//no data on device, no internet connection

textView.setText("No internet connection, unable to download content. Please enable a connection and restart the app.");

if (this.hasDataDownloaded() == false && connec != null && (

(connec.getNetworkInfo(ConnectivityManager.TYPE\_WIFI).getState() == NetworkInfo.State.CONNECTED) ||

(connec.getNetworkInfo(ConnectivityManager.TYPE\_MOBILE).getState() == NetworkInfo.State.CONNECTED))) {

//no data on device, device online

textView.setText("Downloading data...");

new JsoupAsyncTask().execute();

}

} else if (this.hasDataDownloaded() == true) {

//device has data

textView.setText("Loading..");

Intent intent = new Intent(this, MainMenu.class);

startActivity(intent);

}

}

* 1. Similar Apps used by other institutions

**Teeside University**

* Downloadable PDFs

**Swansea University**

* Downloadable PDFs
* Menu with links to website (not in the app)

**Bristol**

* Doesn’t work

**University of South Wales**

* Featured news articles
* View subjects/courses
* Link to website to book open day

**Essex University**

* About Essex University
* About Essex
* Open days
* Courses
* Campus maps
* Directions to get there

**Greenwich University**

* About Greenwich University
* Student Life-Accommodation, SU, Sports and Social clubs
* Studying at Greenwich-department/courses
* Campus Maps

**Stirling University**

* Stirling University Magazine PDF download
* Courses
* Maps
* Scholarships and funding
* Find us
* Open days

**Keele University**

* What Keele has to offer?
* Courses
* Visit/open days
* Maps
* Key contacts
* Social Media

# Annotated Bibliography

This final section should list all relevant resources that you have consulted in researching your project. Each reference should also include a brief annotation.

1. Sylvia Duckworth. A picture of a kitten at Hellifield Peel. <http://www.geograph.org.uk/photo/640959>, 2007. Copyright Sylvia Duckworth and licensed for reuse under a Creative Commons Attribution-Share Alike 2.0 Generic Licence. Accessed August 2011.  
     
   This is my annotation. I should add in a description here.
2. Mark Neal, Jan Feyereisl, Rosario Rascunà, and Xiaolei Wang. Don’t touch me, I’m fine: Robot autonomy using an artificial innate immune system. In *Proceedings of the 5th International Conference on Artificial Immune Systems*, pages 349–361. Springer, 2006.   
     
   This paper…
3. W.H. Press et al. *Numerical recipes in C*. Cambridge University Press Cambridge, 1992.  
     
   This is my annotation. I can add in comments that are in **bold** and *italics*and then further content.
4. Various. Fail blog. <http://www.failblog.org/>, August 2011. Accessed August 2011.  
     
   This is my annotation. I should add in a description here.
5. Apache Software Foundation (2014) “*Apache POI - the Java API for Microsoft Documents*” (Online) Available at: <http://poi.apache.org> Accessed: 14th March 2014.
6. Apache Software Foundation (2004) “Apache License, Version 2.0” (Online) Available at: <http://www.apache.org/licenses/LICENSE-2.0> Accessed: 14th March 2014.