

CM30082 Individual Project Handbook

University of Bath – Department of Computer Science

October 2, 2022

Academic Year 2022–2023

The final year project is the climax of your degree. It is an opportunity for you to explore your favourite topic and to express your individual view of the subject.

It is a major undertaking, requiring consistent effort throughout the year. In order to facilitate that consistency, you are asked to submit a succession of reports. In mid-February, you will demonstrate the work done up to that point, worth 10% of your mark, and ultimately, you will submit a Dissertation, worth 90% of your mark.

Important Submission Dates

Project Proposal	Fri 4 November 2022, 8 PM
Literature, Technology and Data Survey	Fri 2 December 2022, 8 PM
Demonstration of Progress (10%)	Mon 20 February 2023, 8 PM (TBC)
Dissertation (90%)	Fri 5 May 2023, 8 PM (TBC)

All Honours students must pass the individual project in order to receive an Honours degree. Failing the project will result in either an unclassified degree or an ordinary degree.

If you do any of your project work on your own PC instead of on the BUCS file system, then it is entirely your responsibility to make and keep backups. A crashed hard disk on your home PC or laptop or a lost/corrupted USB drive will not allow you a late submission of your Dissertation. The BUCS filestore is backed up regularly and will provide some possibility for retrieving lost information. However, do not expect them to backup every night. It is far safer to also keep your own backups, even if you are using the BUCS system.

1 Selecting a Project

Some project ideas appear on the project website

<https://moodle.bath.ac.uk/course/view.php?id=357§ion=4>

Alternatively, you might have your own idea. In either case, you will need a supervisor.

Your project should enable your markers to identify your capacity to:

- conduct a literature search of previous related work and reflect on that work in a spirit of critical enquiry;
- produce and follow a plan for the execution of your project, recognising the constraints of time and resources;
- evaluate the processes applied and the products produced in a spirit of critical appraisal.

Selecting a level of difficulty for your project is delicate and important. Developing a new version of an existing product without innovation would make for a weak project, as would a project that requires so much effort that you are unable to complete it in time. Your supervisor will provide guidance on this.

All our degrees are BCS-accredited. For BCS-accreditation, projects must require the synthesis of information, ideas and practices to provide a quality solution to a software question, meeting a real need in a wider context, together with an evaluation of that solution. That solution will usually include software. If it does not, you need to give a clear explanation of how it meets the BCS guidelines (<https://www.bcs.org/media/1209/accreditation-guidelines.pdf>).

The project coordinator will give you instructions on how to select a project and a supervisor at the beginning of the academic year.

2 Supervision

Your supervisor will provide you with guidance, but will not do the project for you. You are responsible for its planning, execution and completion. Your supervisor will:

- provide advice and feedback on your Project Proposal, on your Literature, Technology and Data Survey, on your Demonstration of Progress and on drafts of your Dissertation;
- normally mark your Dissertation and meet your second marker to agree a mark.

Your supervisor must ensure that, within reasonable confidence, the work submitted by you is your own. If there is any suspicion of work submitted that is not your own, your supervisor is obliged to inform the project coordinator.

In the unlikely event that you have difficulty with your supervisor, you should inform the project coordinator promptly. If a resolution cannot be found, the project coordinator might appoint an alternative supervisor for the remainder of your project.

If you do not seek supervisor support, follow supervisory advice, or put in appropriate effort, neither your supervisor nor the project coordinator will be able to help you.

A second marker will be appointed to provide a 'blind' second mark for your project after the submission of the Literature, Technology and Data Survey. In order to maintain impartiality, you are not normally allowed to be in regular contact with the second marker in regard to your project. Your second marker will:

- provide a mark and feedback on your Demonstration of Progress;
- mark your Dissertation independently of your supervisor;

- meet your supervisor to compare evaluations and agree a mark;
- if a viva is recommended, take the lead role in the viva.

You should regularly check the project website, attend the preparatory lectures, and keep your supervisor informed of your progress, particularly if you are getting behind on your schedule. Your entitlement to supervision time is finite, so use the time well.

3 Feedback

For the duration of the project there are various ways of obtaining feedback regarding your progress.

Your supervisor will be more than happy to discuss your progress at any of the supervisory meetings. More formal feedback points are available when the Project Proposal, Literature, Technology and Data Survey, and Demonstration of Progress are being marked. The former two are ideal to obtain detailed feedback on your academic writing style. Feedback will either be provided via Moodle together with the marks or during a supervisory session. Do not hesitate to contact your supervisor to get more detailed feedback at any stage of the project.

By providing drafts of the materials you are going to submit well in advance, you give your supervisor the opportunity to go through the material and provide you with detailed feedback. However, do note that your supervisor is neither your spell-checker nor your editor. Nor can you expect to give you any (detailed) feedback when you give him/her the draft a day before the deadline. Two weeks is more appropriate. If that is proving difficult, you could try to warn them of a late draft submission. That way they might be able to free some of their time to read your document. Remember, most supervisors are looking after several students.

4 Waypoints

4.1 Project Proposal

Your Project Proposal consists of a brief summary of your project together with a credible plan for achieving it within the time constraints. You may need to consider ethical issues, and you should certainly consider professional and legal issues, IPR and copyright.

The deadline for submitting the proposal is: Fri 4 November 2022, 8 PM.

Ethics

If your project will involve the participation of other people, such as in interviews or usability evaluations, you need to treat them fairly. To facilitate that, you need to:

- answer the questions on the Computer Science 12-Point Ethics Checklist and, possibly, the Checklist for Full University Ethics Sub-Committee Review;

- discuss your answers with your supervisor, amend your plan as appropriate, and, depending on your answers, either submit an EIRA1 form or apply for a Full University Ethics Sub-Committee Review; you have time until the Demonstration of Progress to do so and you will be guided through the process;
- submit your ethics documentation to Moodle.

If your project does not involve the participation of your fellow students or other members of the public, it is unlikely that any particular research ethics will arise but you still need to answer the first question in the 12-Point Ethics Checklist before the Demonstration of Progress and submit it with your Dissertation. You should still review the BCS Code of Conduct and Good Practice and account for any issues relating to professional ethics in your report.

Precise and up-to-date instructions on how to deal with the ethics documents are on the Moodle page of this unit and at <https://moodle.bath.ac.uk/course/view.php?id=58476§ion=1>.

How Do I Answer the Questions on the 12-Point Checklist?

The easiest way to do this is to edit the checklist directly, replacing the text beneath each question with a statement of how you address the issue in your project. For example, the final item on the checklist is:

Do you have a data management plan for all recorded data? [All participant data (hard copy and soft copy) should be stored securely, and in anonymous form, on university servers (not the cloud). If the study is part of a larger study, there should be a data management plan.]

You could answer this by stating:

The study will record error data in aggregate form only (totals). No personally identifiable information will be collected.

Another possible answer might be:

Participants will be video recorded. Each video recording will be kept with a numerical identifier for each participant. Video will be burned to a DVD and kept in a secure location.

A third possible answer could be:

Members of the public are to be observed interacting with an automated ticket machine in a public location. Descriptive notes will be made and photographs will be taken. Only photographs that do not identify individuals will be retained. If members of the public request that records of their activities are not kept, they will be destroyed immediately.

In each case, you should think about the relevant item on the checklist as an aid for you to think clearly about exactly what you will be doing and exactly what you are asking your study participants to do. The over-riding ethical concern is to ensure that participants in your research are properly informed about what you are trying to achieve and what they are being asked to do.

IPR and Copyright

You should be aware of university regulations on copyright and IPR.

<https://www.bath.ac.uk/publications/university-ordinances/attachments/Ordinances-revised-November-2021.pdf>

In most cases, copyright and IPR belongs to the student, unless it uses IPR belonging to the university in collaboration with a member of staff. A summary of the IPR policy can be found at

<http://www.bath.ac.uk/university-secretary/legal/copyright/copyright-essentials.html>

If you wish to include copyright material belonging to others in your Dissertation, you are advised to check with the copyright owner that they will give consent for the inclusion of any of their material in the Dissertation. If the material is to be copied other than by photocopying or facsimile then the request should be put to the publisher or the author in accordance with the copyright declaration in the volume concerned. If, however, a facsimile or photocopy will be included, then it is appropriate to write to the publisher alone for consent.

Copyright and IPR cannot be used as a reason not to submit the Dissertation or the software on which it is based.

4.2 Literature, Technology and Data Survey

We ask for a Literature, Technology and Data Survey (the 'survey' from now on) from you in order to check your progress and provide feedback. Writing your survey will give you a start towards writing your Dissertation. You may modify it before including it in your Dissertation.

The deadline for submitting the survey is: Fri 2 December 2022, 8 PM.

4.3 Demonstration of Progress

The Demonstration of Progress is a checkpoint at the start of Semester 2: you will have a few minutes to present to your second marker, via a video, the rationale for your project, the key background work, the work you have done, and concluding reflections. The Demonstration of Progress contributes 10% towards your overall project mark.

Your supervisor will advise you on the best way to communicate your progress in the allotted time. For example, you might want to show software you produced in action or you could

present some slides illustrating the key points of your project. You will receive feedback and your mark from the project coordinator.

By the time you do your Demonstration of Progress, your 12-Point Ethics Checklist needs to be finalised and approved by your supervisor. Also, if your research involve human participants, either you or your supervisor need to have submitted either an EIRA1 form or have applied for a Full University Ethics Sub-Committee Review (the choice depends on certain answers in the Checklist for Full University Ethics Sub-Committee Review). There is a 10% penalty on the Demonstration of Progress mark if the necessary ethics documents are not provided.

The deadline for the Demonstration of Progress is Mon 20 February 2023, 8 PM (TBC).

5 Dissertation

Dissertations must contain at most 10,000 words excluding front matter, bibliography and appendices. Dissertations contain the following elements, in order:

- cover page,
- access page,
- title page,
- abstract,
- table of contents,
- acknowledgements
- introduction,
- literature technology and data survey,
- main body,
- conclusions,
- bibliography,
- appendices.

All except acknowledgements and appendices are requisite. Cover, access and title pages, and abstract, table of contents and acknowledgements are considered the front matter.

The survey and main body are the critical parts of your Dissertation: we shall address the structure and writing of them in Subsections 5.1 and 5.2. But we shall first summarise all components of your Dissertation in order.

Cover Page

The first page of your submission must read as follows:

- The full title of the Dissertation
- Your name
- The full title of your programme of studies
- The academic year (*e.g.*, 2022–2023)

Access Page

Restrictions of the use of Dissertations by others for the purposes of study should be the exception rather than the rule. If confidential information (*e.g.*, information which is the subject of a patent application or information about which a prior IPR agreement has been signed) is included in a Dissertation, some restriction is necessary. If access is to be restricted, permission must be sought through the procedures set out in the appropriate Regulations. The access page consists of a statement as follows:

If there are no restrictions:

This Dissertation may be made available for consultation within the University Library and may be photocopied or lent to other libraries for the purposes of consultation.

If there are restrictions:

This Dissertation may not be consulted, photocopied or lent to other libraries without the permission of the author¹ for 3 years² from the date of submission of the Dissertation.

Title Page

This page must read:

FULL TITLE OF DISSERTATION

submitted by

Copyright

Attention is drawn to the fact that copyright of this Dissertation rests with its author. The Intellectual Property Rights of the products produced as part of the project belong to the author unless otherwise specified below, in accordance with

¹If the author has included in the Dissertation confidential information obtained from a third party whose interests also require protection and from whom permission for consultation, photocopying or lending is also to be sought, the third party's name will be inserted after 'the author'.

²Three years is the normal amount, but you can reduce it.

the University of Bath's policy on intellectual property (see https://www.bath.ac.uk/publications/university-ordinances/attachments/Ordinances_1_October_2020.pdf).

This copy of the Dissertation has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with its author and that no quotation from the Dissertation and no information derived from it may be published without the prior written consent of the author.

Declaration

This Dissertation is submitted to the University of Bath in accordance with the requirements of the degree of Bachelor of Science in the Department of Computer Science. No portion of the work in this Dissertation has been submitted in support of an application for any other degree or qualification of this or any other university or institution of learning. Except where specifically acknowledged, it is the work of the author.

Abstract

The abstract immediately follows the title page and is presented on a page on its own. It consists of a brief summary of no more than 300 words, outlining the main aims and achievements of your Dissertation.

Table of Contents

This provides a list of chapter, section and subsection headings with page numbers. You are strongly advised to use \LaTeX or other word-processing software to auto-generate this page. This ensures that the details are correct and considerably cuts down on boring work.

Acknowledgements

Students usually acknowledge their project supervisors, often also others who have helped them during their studies, typically including family and friends. The acknowledgements should be succinct.

Introduction

This section will be relatively short. It should introduce the reader to the problem that is to be tackled and provide a brief indication of the context within which the problem exists. The most important part is an explanation why the problem is worthy of study. It should also include an outline of the structure of the Dissertation, providing a framework for the reader.

Literature, Technology and Data Survey

This is normally what you submitted in Semester One, but may be modified in the light of progress since then.

Main Body

This, together with the introduction, survey and conclusion, contains the substantive sections of the project. The structure will depend very much upon the type of project you do, see Subsection 5.1

Conclusions

The conclusion should highlight the achievements of the project, identify things that have gone well, note areas which could have been done better or tackled in a different way, and relate the work of the project to the introduction and related work as discussed in the survey. The number of words excluding front matter, bibliography and appendices must be indicated at the end of the Conclusions.

Bibliography

You need to locate your project work within the subject discipline, i.e., you need to explain how your project relates to other work in the field, and that needs to be supported by precise references, preferably to archived, refereed material. The references will be gathered into a Bibliography.

All references must be identified as they are used, including points where you are using ideas even if not quoting. If you are quoting, the extent of material quoted must be clearly identified. All references should be in a consistent *standard* format, normally either the 'Numerical' or the 'Author-Date' System (as seen in the Harvard systems).

For an example of the Numerical system, your text would read:

... a solution to the consecutive state problem was presented [1].

and the reference would appear in your Bibliography as:

[1] Barry, A.M., 'Aliasing in XCS and the Consecutive State Problem : 1 - Effects', *Proceedings of the Genetic and Evolutionary Computing Conference, GECCO'99*, pp. 19-26, Morgan Kaufmann, 1999

For an example of the Author-Date system, your text would read:

... a solution to the consecutive state problem was presented (Barry, 1999).

and the reference would appear in your Bibliography as:

Barry, A.M. (1999), 'Aliasing in XCS and the Consecutive State Problem : 1 - Effects', *Proceedings of the Genetic and Evolutionary Computing Conference, GECCO'99*, pp. 19-26, Morgan Kaufmann

A typesetting system like \LaTeX will automatically collate a bibliography and insert appropriate references in a single selected style. If you are using a word-processor, you will have to do more work to ensure that the references are correct and in the same style.

The way in which references are written for books, journals, conference papers and internet references differs. The following are (fictitious) examples using the Author-Date system (notice that where an author has multiple publications in one year a letter is added to the year to differentiate the publications):

Barry, A.M. (2000a), 'Data Mining with XCS', *Proc. Famous Intl. Conf.* (FIC00), 23-34, Bath Publishers.

Barry, A.M. (2000b), *Perfect Projects*, 2nd Edition, Bath Publishing, London.

Barry, A.M. (2002), 'Writing Brilliant Project Reports', available from the Internet [<http://www.bath.ac.uk/reports.pdf>] (5 October 2002)

A comprehensive yet compact guide to citing and references is available from the Library website.

Appendices

Appendices are the place for details that would otherwise break up the flow of your main text. In particular, it is usual to place your code in an appendix. You should provide a short overview at the start of such an appendix to allow the reader to find their way around the code. If you have a large amount of code, then you should consider including only a subset of it, only the most important or most complex components. In general, if the code listing is longer than 20 pages, then you should leave some of it out.

The appendices are normally numbered separately from the main document (Appendix A, B, C, . . . , rather than Chapter 1, 2, 3, . . .). A document processing system like \LaTeX will provide the appropriate numbering, but you may have to be more careful if using a word-processor.

5.1 Possible Structures of the Main Body

The structure of the main body of your Dissertation will depend upon the kind of the project you do. Here, we will discuss possible structures for two main forms of project, a software development project and a research project.

5.1.1 Software Development Project

The fact that this kind of project focuses on the development of a software product does not remove the requirement to ensure that the Dissertation is a piece of academic writing, and the Dissertation should reflect this in an appropriate investigation of the context in which the problem exists – relevant technologies, related products and algorithms – within the introduction and the survey. The Dissertation should ensure that appropriate evaluation and critique is evidenced throughout. To facilitate this, the chapters of the Dissertation describing the development process should not be a simple exhaustive list of the requirements/design/classes or functions, etc. Rather, each chapter should provide an overview of the task(s) undertaken and a high-level walk-through the main features of that stage, and then identify key (and

interesting) areas and/or issues that the remainder of the chapter will discuss. The details can be placed within the appendices and referred to as required.

Your overall Dissertation needs to be structured as described at the start of this section, but within the main body of your Dissertation, main chapters for this kind of project will typically be:

Requirements Analysis and Requirements Specification This chapter should identify the process of requirements capture and analysis that was adopted (explaining why a particular technique or method was adopted rather than competing techniques, if necessary). The section should identify and discuss key requirements, and focus particularly upon areas of particular challenge, difficulty or conflict. An appropriate scoping of the desired system is a key part of any project, reflecting an appropriate understanding of the resource limitations that impinge on the project. The chapter should be careful to identify areas of the process of requirement analysis and specification which were particularly ‘successful’ or demonstrate good practice, and be appropriately self-critical of areas where difficult compromises have had to be made.

Design The design chapter should indicate how the problem, as specified within the requirements, is analysed to create a potential solution, and how the details of the proposed solution are captured using an appropriate method. The design chapter will typically address the problem of method choice, but should not simply regurgitate the well-known details of myriad competing design methods. The chapter should then introduce the overall architecture of the design (the high-level design) so that the reader can gain an understanding of the approach being adopted. The chapter should *not* be allowed to become a catalogue of key classes or design components. Instead, it should select key parts of the design which are particularly important, illustrate the selection of particular approaches from a range of possible design decisions, or show the application of particular design patterns for the solution of identified problems. Of particular importance are areas of the design which resolve key viewpoint conflicts that were identified in requirements capture and analysis.

If the user interface specification and design is an important part of the project, then it may be appropriate to dedicate a separate chapter to this component of the system. It is common for project students to spend considerable time rehearsing principles of user interface design that are readily accessible from key texts. Whilst it is important that these principles are used and applied, extensive regurgitation of this material is often unnecessary and simple reference can be made to the appropriate sources. If, however, the project is investigating new approaches to user interface development, then a more in-depth consideration of the principles of user interface design may be appropriate in the survey.

Detailed Design and Implementation This chapter will follow the same approach as the Design chapter, presenting an overview of the software architecture and a high-level discussion of the implementation process. It will reflect on appropriate implementation approaches, algorithm choices and language choice, using the more detailed discussion provided within the survey to justify decisions taken. It will include discussion of any ancillary techniques used to ease implementation (such as the use of source code control systems and associated release plans). The discussion should not descend to become a simple catalogue of classes or

methods, but should select non-trivial components, interesting implementation techniques, or important algorithm choices to discuss. It is important to take time to decide which design and implementation issues warrant discussion and which do not.

System Testing Although the test plan will have been developed after the development of the requirements specification, the *process* of testing should be discussed following the discussion of the implementation. The chapter should begin with a description of the testing strategy and how this is reflected within your test plan. It should provide a high-level overview of the test plan, and then focus on particular testing outcomes which are of interest. For example, a particularly complex section of code or interaction between classes may require very careful data selection and results extraction in order to demonstrate conformance to the requirements, and the problems involved in generating and applying appropriate test data might be discussed. On the other hand, one or more tests may reveal that the behaviour was not as expected, and it might be appropriate to discuss how further tests were created to isolate and enable rectification of the problem. You should evaluate how appropriate the processes and techniques you applied were in hindsight.

It is unlikely, given the constraints upon the project, that detailed and sufficient tests can be applied across all parts of the software product. If you have to make difficult choices about the areas you will test, you should explain how these choices were made and demonstrate how these choices maximise the benefit of testing whilst reducing effort required.

As in the other chapters, details of the test plan and results are likely to be inappropriate for inclusion within the body of this section, and should normally be relegated to the appendices.

5.1.2 Investigation/Research Project

The investigation, or a research project, is typically a project in which, based on the survey, hypotheses about a particular approach, technique or solution are proposed and tested through appropriately developed experimentation. Often a prototype system or a program implementing an hypothesised approach will be created and the experiments will be conducted on or using this software.

There is a tension in such projects between the need to discuss the development of the software used within the experiments and the need to detail and discuss the experimental method and the experiments themselves. In general a decision should be made as to whether the major effort will be in the software development or within the experimentation. In the former case, it may be more appropriate to follow the structure of the software development project above with an additional chapter on the experiments and their results. In the case where the experiments are the most important element in the project, or where previously implemented software is being adapted and applied experimentally, the following chapter headings and content will normally be more appropriate:

Experimental Hypotheses This chapter will use the background to the problem identified within the introduction, and the details of previous related work provided within the Literature and Technology survey, to lead to one or more hypotheses which are going to be tested in your investigation. The chapter will typically be short, drawing together the relevant threads of the survey to identify why a new or alternative approach to a problem may be appropriate.

It should then identify in a clear and concise manner (usually in one or two sentences) the main hypotheses that are to be tested. This will possibly be followed by further discussion of the techniques that will be applied or experimental approach that will be used in order to test the hypotheses.

Note that this chapter may not be necessary – it could be more appropriate to include it as a section which forms the natural culmination of the survey.

Design of Experiments This chapter should identify the choice of experiments which you will undertake in more detail. Typically it will identify the particular test ‘environment’ that will be used — the highly controlled part of the problem domain which the experiment is going to manipulate. It should identify how potentially confounding variables in the problem domain will be controlled (how you will ensure that the results you see actually reflect the application of the new approach and do not result from some side-effect). If software is to be written for the experiments, the section should detail the main algorithm(s) sufficient to allow another person to reproduce the experiments. If the software is particularly complex, one or more chapters may be required to document the technique appropriately. If existing software is being applied, then the chapter should identify the software and (where appropriate) any changes that have been made to it. Any parameterisation of the experimental software or approach should be identified and discussed, and the parameters selected for the various experiments identified. Again, it is important that sufficient detail is presented in a succinct and unambiguous manner to enable the work to be repeated. For each experiment, it is very important that the criteria by which the experiments will be judged successful are clearly stated — this may involve the use of appropriate [statistical] confidence tests.

Experimental Results This chapter will describe how the experiments were undertaken, reflecting the experimental design identified in the preceding chapter. Where more than one experiment is undertaken, they will usually be presented in turn. The results of each experiment are shown using appropriate textual and/or graphical presentations and/or summary statistics. The discussion of the results may highlight expected results or trends, or highlight unexpected results. If the results prompt further experimentation to investigate particular phenomena more closely, these experiments and their results will also be included within this chapter. Where the results of experiments are not readily summarised or easily graphically presented, it may be particularly appropriate to discuss the results within the chapter and refer the reader to relevant appendices for the detailed results.

Analysis of Results This chapter analyses the results obtained, possibly applying appropriate statistical confidence tests, in order to evaluate the hypotheses. Using the results it will be concluded that the null hypotheses are supported or denied. The implications of these findings should be discussed, and the significance of the results for the field identified. It may be appropriate to reflect upon whether the experiments chosen were appropriate, and if the results were not useful or inconclusive what needs to be done in order to construct more useful experiments. It could also be appropriate to decide whether the methodology chosen for the investigation was appropriate, and what changes might be necessary.

Note that this chapter should be distinct from the Conclusion chapter of the project, which will include reflection upon the results but will go beyond the experimentation itself to reflect upon the project as a whole — what was learnt from it and its relevance to your studies.

5.2 Dissertation Format

The content of your Dissertation is most important, but the format and writing come a close second. If your project is badly formatted or written, readers might not be able to identify the main points you have tried to make. Dissertation conclusions are sometimes read first thing by supervisors and external examiners, therefore they have to be especially well written. Do not include source code to 'beef up' dissertations. Try to privilege quality over quantity.

Here are some pointers in regard to layout and style.

Page Appearance

Do not try to be innovative and clever with the document style. The Dissertation should convey information about the project that was undertaken rather than show off experience in document layout. The most important aspects of document design are clarity and consistency:

- **Clarity** – choose layouts, fonts and so on, so that the reader finds it easy to read;
- **Consistency** – keep to the chosen layouts, fonts and numbering conventions throughout the document.

Most word-processing packages or type-setting packages allow the user to identify the styles of paragraphs and sections. These ensure that the package enforces the layout and appearance, and so maintains consistency without the author having to recall the conventions that were used previously. It is important to make use of these facilities, which will require time to set up before the document production is started.

Fonts and Font Size Choose a font that is easy to read and conveys the right message about the information that it is being used to report. Although there may be a need to use several different fonts, do not use too many, because this can make a page look far too 'busy' and hard to read. For reproduction of code it is usually appropriate to use a mono-spaced font so that the layout of the code is preserved.

You also need to consider the font sizes that will be used. For the main text, *a font size of 12 point is strongly recommended*. Font sizes can differ considerably from font to font. Once the font and the font size to be used in the document has been chosen, do not vary it:

Different font sizes can be very distracting to the reader.

Spacing Appropriate use of white space will make your document look attractive and easy to read (though, obviously, do not use too much, or the document will look quite strange).

A decision is required on whether the text will be fully justified, or simply left justified. This document is fully justified, giving it a more professional appearance but possibly making it more difficult to read. It is recommended that justified text is used in the Dissertation, and it is important to remain consistent in the use of the chosen justification style throughout the Dissertation.

Numbering

It is normal practice to number chapters, sections and subsections, and for the numbering system adopted to clearly identify the structure of the document. \LaTeX and some word-processing packages will produce a table of contents on demand, and the layout of the table of contents generated by these tools is normally appropriate. It is difficult to produce a table of contents by hand, but if this is required it is important to ensure that layout conventions in the table of contents are adhered to.

The Chapters are the first level of units which divide up your Dissertation, and are numbered 1, 2, 3, and so on. Do not start with a Chapter 0. The second level units are sections which divide up each chapter. These are numbered so that it is immediately clear to which chapter they belong. For example, 1.1, 1.2, 1.3 are in Chapter 1, while 2.1 and 2.2 are in Chapter 2. In this sample contents list there are also third level units, which divide up some of the sections. These subsections are also numbered so that it is clear which section they belong to. Thus, 1.1.2 is in Section 1.1, while 2.2.1 is in Section 2.2.

It is not normal practice to use any further levels of numbering, such as 1.2.2.1. Any further subdivision of the contents that is required should use un-numbered headings, which should not appear in the contents list.

Diagrams If diagrams, or figures as they are more usually called, are to be included then these will also be numbered. It is usual to number a figure according to the chapter it is in. Thus the first figure in chapter 1 will be Figure 1.1, the second figure will be Figure 1.2, and so on. Do not number figures according to the section or subsection they are in; that is, a diagram which resides in 1.3.2 will still be numbered Figure 1.x, not Figure 1.3.2.x.

Where a figure appears in your Dissertation you must give it an appropriate number and a caption that describes what it shows.

Tables Tables are numbered and named in a manner similar to that of figures. The numbering for tables and figures should each increase independently of one another. Figure 1.1 would be followed by Figure 1.2, but not Table 1.2 unless an earlier table had appeared in Chapter 1.

Equations Equations are also numbered where the equation is important or will be referred to elsewhere in the text, such as Equation 1. Equations that represent an intermediate result or which appear in the flow of the text and will not be referred to again need not be numbered. Notice that the number occurs to the right hand side of the equation. The equation number may be incremented from 1, or may include the chapter number, such as 1.1: just select a system and apply it consistently.

$$p' = p + \beta (P - p) \quad (1)$$

More complex equations can be included, for example:

$$\kappa = \begin{cases} \ln(\alpha) \frac{\varepsilon - \varepsilon_0}{\varepsilon_0} m & (\varepsilon > \varepsilon_0) \\ 1.0 & (\text{otherwise}) \end{cases} \quad (2)$$

Referring to Sections Rather than repeat earlier text, it is appropriate to refer to the section that the text you wish to refer to appears within. 'See Chapter 1' would refer to a chapter, and to refer to a section or subsection it is normal to say 'see Section 1.1' or 'see Section 1.1.2'. To refer to a point in a bullet list a phrase like 'see bullet point 2 in Section 1.3.2' might be used. Appendices are treated like chapters, but using the letter of the Appendix rather than a number.

Most word-processing and text layout packages allow the identification of cross-references so that the package can insert the correct reference automatically when instructed. This facility is extremely useful and prevents many errors. You are strongly advised to make use of these automated facilities whenever possible.

Writing

Your Dissertation must be expressed in good English. In this context, good English means being clear, interesting, informative and lexically and grammatically correct. There are excellent books on both grammar and expression in the Library: you are well advised to look at them.

It is also important to maintain a professional attitude in your writing. Do not use the Dissertation as an opportunity to complain about things that went wrong. Also do not write in a 'jokey' style or use casual language or slang. And do not use complex language in an attempt to impress: it is almost always used incorrectly, appears 'false' and therefore has the opposite effect.

It is important to proof-read your Dissertation carefully (if you are not a native English speaker, ask a native English speaker to check your Dissertation to correct phrasing errors that you may not detect). It is very easy to miss out words or write a sentence which does not make sense when typing the Dissertation. Some word processors have grammar checkers, but these are rarely beneficial: use a friend or member of your family to check the grammar and sentence construction.

You should *always* use a spelling checker to ensure that your spelling is correct, but spelling checkers cannot pick up missing words, nor can they recognise a mistake where the wrong word is used or a word is missing (for example, using 'were' instead of 'where'). Again, careful proof-reading is needed.

Finally you need to use a dictionary to ensure that the meaning you are attributing to a word is correct. This is a frequent error. Here are some actual examples from coursework:

'the conjunction of these two components provides the final solution...'

where 'conjunction' should have been 'combination'.

'The attainment of items on the screen allows the user to...'

where 'attainment' should have been 'arrangement'.

5.3 Submitting Your Dissertation

It is vital that the Dissertation is submitted with the appropriate layout. You *must* submit your Dissertation in accordance with the following instructions:

1. The Dissertation should be word processed or typeset and it must contain at most 10,000 words excluding front matter, bibliography and appendices. This number must be indicated at the end of the Conclusions.
2. All pages must be numbered, including introductory pages, appendices, reduced copies of computer print-outs, etc. A single sequence of Arabic numerals should be used for the main body of the Dissertation.
3. One electronic copy of the Dissertation in PDF must be submitted on Moodle by the submission deadline. You should name the PDF file you create as follows:

surname-initials-dissertation-20XX-YY.pdf

replacing the items in italics appropriately, where 20XX-YY is the academic year.

4. You should upload any code or software in ZIP files to Moodle. Please include a readme file within one of the ZIP files if instructions are required to run your code. You should name the archive files:

surname-initials-code-20XX-YY-N.zip

where 20XX-YY is the academic year and *N* is the file number (from 1 to 19). Moodle will allow you to upload up to 20 files, each to a maximum of 50MB (this is a restriction that we cannot circumvent) – one of the 20 files will be your PDF (not zipped). This leaves you with 19*50MB of storage. You can zip all materials you believe are necessary (code, data, etc.) splitting it into volumes of up to 50MB each (all good compression software should be able to do that). If Moodle's storage capacity is not enough, use, in agreement with your supervisor, a reliable cloud storage facility that retains the data for at least three months (for example, GitHub). In no circumstances you are allowed to upload personal data outside of university servers.

5. All the necessary ethics documents need to have been submitted to Moodle. Those documents that require approval need to have been approved.

5.4 Marking Method and Criteria

In marking a Dissertation, the following criteria will be used:

1. Basic Criteria:
 - (a) Understanding of the problem
 - (b) Planning and control of the project
 - (c) Selection and deployment of appropriate techniques

- (d) Achievement of the objectives of the project
- (e) Quality of the products of the project

2. Additional Criteria:

- (a) Clarity of objectives and/or hypotheses
- (b) Knowledge, critical evaluation and use of the literature
- (c) Justification of decisions taken
- (d) Solution of conceptual problems
- (e) Selectivity, clarity and focus in discussion
- (f) Critical evaluation of own work and achievements
- (g) Planning and effort (only for the supervisor)

3. Exceptional Criteria:

- (a) Clear evidence of originality (conception or novel application of concepts/methods/tools)
- (b) Significant contribution to or extension of existing knowledge/methods/techniques
- (c) Inclusion of a significant amount of material that is publishable in a peer-reviewed national conference (or) production of original products that have significant academic or commercial potential

The 'planning and effort' additional criterion for the supervisor might address situations where a lot of effort went lost due to unforeseen circumstances, despite careful planning.

After consideration of the criteria, each examiner will decide on a classification area for the project according to the following guide: 'A low 1st, i.e., 70-79%, would typically satisfy at least one of the exceptional criteria, with an outstanding 1st, i.e., 90-100%, typically satisfying all of them.'

There is a 10% penalty on the Dissertation mark if the necessary ethics documents are not provided on Moodle.

The mark given to the project will be released along with the other unit marks on the mark transcripts. Under no circumstances should any student seek to obtain an early release of the project mark from their project supervisor or any other member of staff within the Department. In cases where there is a mark dispute between the markers a panel will consider the project and resolve the mark. All projects are made available to the External Examiner for consideration.