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Research proposal, literature review and methodology

MSc Computer Science

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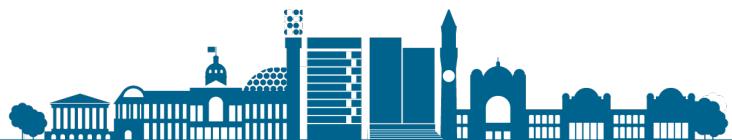


Learning Outcomes

- To learn how to write a research proposal
- To know what to include in a literature review
- To consider some ways of structuring the review
- To explore ways of writing critically about the literature and your findings

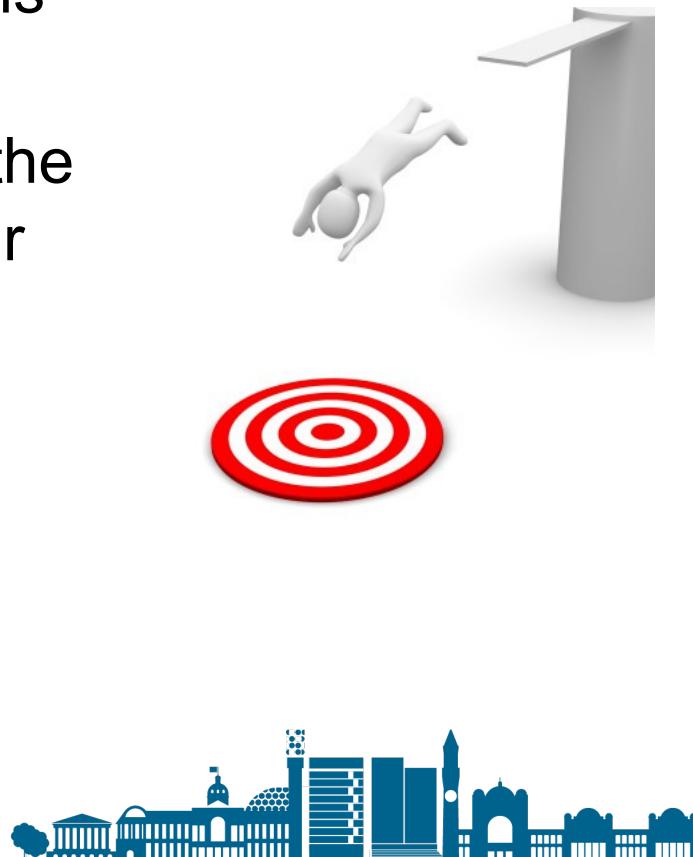


Research proposal



Research proposal

- You are making a case as to why this research should be done
- Your critical analysis and review of the literature is the ‘springboard’ for your research proposal
- This is where you set out to fill the gap(s) in research that you have identified



A good research proposal should...

Propose something exciting and original

Have clear, achievable objectives

Be clear and concise

Be persuasive

Show an awareness of how it fits in with existing research

Show how it could contribute/make an impact



What are you doing & how will you do it

- Think about the **specific aims/objectives** that your study will address
- What is the overall aim of the study? (The ‘*what*’ of the research: what are you trying to find out? What do you hope to do?)
- What are the objectives (The ‘*how*’ – how will you do this?)



A few tips

- Draw on the reading and literature reviewing that you have done
- Be as clear as possible about methods and resources – and the **justifications** for these
- Try to demonstrate who would benefit from this: what would the **impact** be? Who are the ‘beneficiaries’?



Literature review



To begin with...



- What is a literature review for?
- And what do you expect it to include?



What is a literature review?

- An explanation of what research has already been performed in a specific area
- A comprehensive review of the literature available for any given research question
- A summary, analysis and critical evaluation of that literature



What is the point of a literature review?

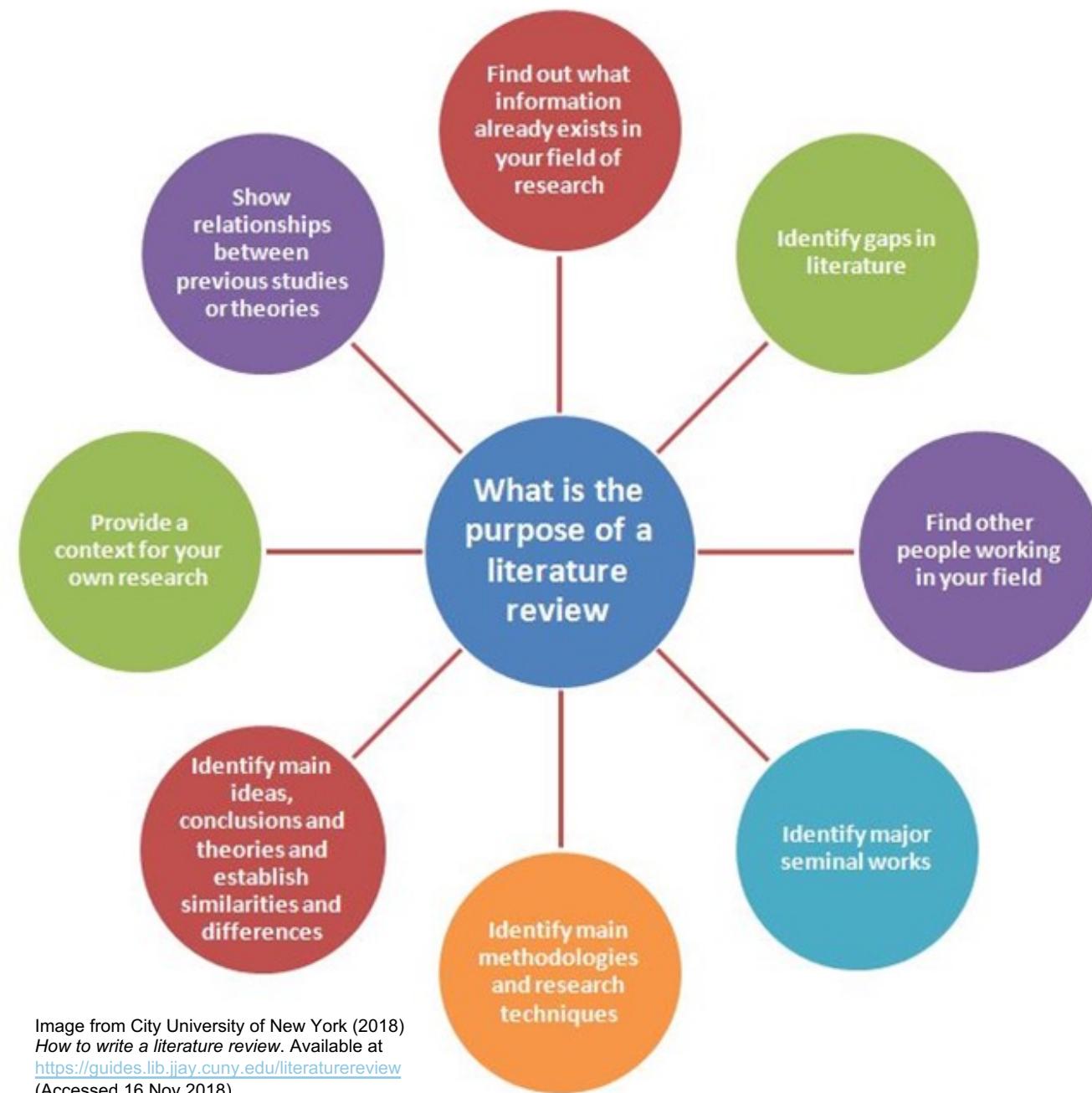


Image from City University of New York (2018)
How to write a literature review. Available at
<https://guides.lib.cuny.edu/literaturereview>
(Accessed 16 Nov 2018)



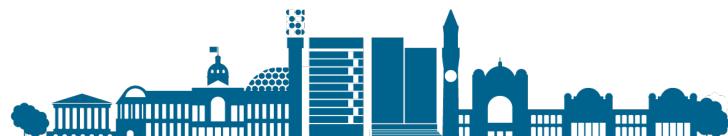
What is a literature review for?

- Its function is to provide an overview of the field relating to your area...
- ...but it is also your way of **situating your research** within the field
- It should demonstrate your evaluation and critical appraisal of relevant studies
- It highlights strengths and weaknesses of approaches, findings or conclusions so far
- It highlights **gaps** – what still needs to be done, and how does your research contribute to this?



Read other examples

- Have a look at other literature reviews online to get an idea
- Search the library catalogue for literature reviews published as journal articles
- Read book reviews and look at the writing style
- To look at an example in your own subject area:
<https://etheses.bham.ac.uk/> (Remember – these are PhD theses)



How to approach your literature review

- Think about your allocated topic
- Start doing some preliminary searches
- Review the results (too many/too few?)
- Conduct a more thorough search
- Start reading
- Re-read, thinking more critically about the articles, their approaches and arguments
- Start planning – what might be a logical order or structure?
- Write up from notes to a draft, and then edit as necessary



Finding appropriate resources

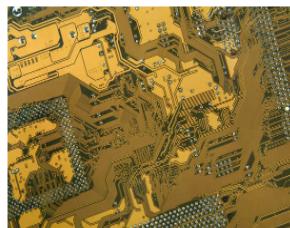
- The [subject guide](#) for Computer Science identifies relevant resources in your subject area.
- Search for [databases](#) within findit@bham.
- Book a [1-1 appointment](#) with one of our skills advisors





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Computer Science



Using good quality resources and citing them correctly will enhance the quality of your work.

This guide brings together key resources in your subject.

Using this guide

Use the tabs on the right or the links below to navigate around this guide

- [Books and Ebooks](#): Read around your topic and ensure that you have a balanced overview of your topic.
- [Journals](#): Use bibliographical databases to find academic journal articles, conference papers, reports etc which provide the latest in-depth discussion of your topic
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<https://libguides.bham.ac.uk/subjectsupport/compsci#s-lg-box-15587324> 

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Reading and Notetaking for your Literature Review



Critical reading

Studies, findings
and conclusions
in your topic
area.

Disagreements;
controversy;
alternative
perspectives.

Definition of
relevant terms.

Potential gaps in
literature.

Calls for further
research
relevant to your
topic.



Why am I reading this?

- To further inform my background understanding of a subject?
- To understand how a particular idea/theory has evolved?
- To find different, challenging view points?
- To provide specific data or evidence?



Summarising as you read

In your own words, make notes on:

- Research question(s)
- Methodology used
- Results
- Conclusions
- Any strengths, weaknesses or gaps in research



	Article one	Article two	Article three
Research question	To quantify health impact of increasing the price of alcohol across Europe .	2012 update of Sheffield Alcohol Policy Model for population of Scotland	News article
Methodology	Dynamically project changes in population health using alcohol consumption data and corresponding country disease data.	Statistical modelling.	None given. Statements made without any evidence provided in support.
Results	Increasing price of alcohol to Finnish model would postpone significant numbers of alcohol related deaths over 10 years and lead to a reduction in chronic diseases.	A minimum price increase will result in a decrease in alcohol-related hospital admissions and deaths . Also result in a decrease in alcohol-related crimes, absenteeism from work and unemployment from work due to alcohol-related problems .	Minimum pricing policy is regressive taxation , there is no evidence to back up health benefit claims and illegal under European law.
Conclusions	Reducing excessive drinking in EU would result in significant gains in population health .	A minimum price increase will result in a decrease in alcohol-related hospital admissions, deaths, crimes, absenteeism .	Minimum pricing policy wouldn't address health claims and has other negative side effects for society.
Weaknesses	Conceptual, predictive study .	Conceptual, predictive study .	No evidence to back up claims.



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Writing Critically about the Literature



Writing critically

As noted, the main purpose of the review is to pull out:

- the **key ideas and findings** from past research
- and '**locate**' your study within that broader body of knowledge

But it's not just a summary or description of the studies, it's an assessment of key findings, and a justification for your own approach.

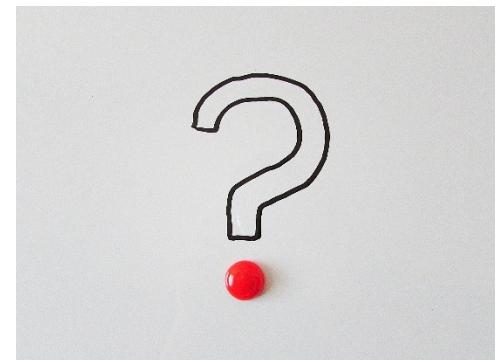
Therefore, the emphasis is on *critical* rather than descriptive writing



Activity

Compare and contrast the following two paragraphs

- Which one is more effective and why?
- Can you identify the features of descriptive and critical writing?



Much has been written about the need for defence mechanisms. The persistent growth of vulnerability and threats has also emphasised the serious need for defence mechanisms. The main technology of network security focuses on access control, firewall and information encryption. It is also important to acknowledge the common issues related to bugs and deficiencies. For instance, a firewall alone is unable to detect intrusions occurring from within the network (Wankhade and Chatur, 2014). Hence, the intrusion detection system (IDS) has become a popular option. IDS is recognised as one of the components in the security arsenal as “defense in depth” (Northcutt et al., 2008). The use of IDS will enhance the security aspect of a network.

Adapted from Kamarudin, Maple and Watson (2019)



The highest proportion of “unknown” attacks each year has emphasised the serious need for defence mechanisms. The unknown attack is generally known as a zero-day attack in the network security field (Levy, 2004). The persistent growth of vulnerability and threats has also emphasised the serious need for defence mechanisms. The main technology of network security focuses on access control, firewall and information encryption. However, it is also important to acknowledge the common issues related to bugs and deficiencies. For instance, a firewall alone is unable to detect intrusions occurring from within the network (Wankhade and Chatur, 2014). This further explains why the intrusion detection system (IDS) has become a popular option. In addition, IDS is recognised as one of the components in the security arsenal as “defense in depth” (Northcutt et al., 2008), that acts as a complement to the existing security appliances. Although the IDS does not guarantee the security aspect, it will be greatly enhanced if integrated with other security measures, such as vulnerability assessments, data encryption, user authentication, access control, and firewalls.

Kamarudin, Maple and Watson (2019)



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Kamarudin, Maple and Watson (2019)



What to consider when critiquing the literature:

- Date research was conducted
- Impact and reach of the research
- Breadth and depth of research
- Overgeneralisations and assumptions
- Methodological limitations & strength
- Recommendations and calls for further research



Critiquing the literature

□ Overgeneralisations and assumptions:

‘In Harper’s study (2018) students responded well to the teaching strategy and measures of performance showed significant improvements. However, these improvements may in part be due to the smaller class sizes used in the study, and may not occur in larger mixed ability classes’.

Adapted from the University of Queensland (2019) *Examples of Critical Analysis*. Available at:
<https://www.uq.edu.au/student-services/learning/examples-critical-analysis>.
(Accessed 14 October 2019).



Critiquing the literature

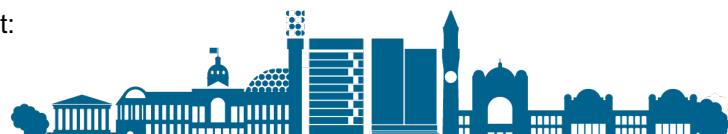
□ Methodological limitations:

'While studies by Smith (1999), Brown (2011) and Green (2016) generally claim women are superior to men in understanding body language, Wright (2017) has found no difference. Furthermore, methodological problems raise questions about the positive results. For instance, Brown's (2011) work looked solely at facial expressions asking participants to make judgements by looking at photographs. Whether this would be valid in real-life situations was not explored.'

Adapted from the University of Queensland (2019) *Examples of Critical Analysis*. Available at:

<https://www.uq.edu.au/student-services/learning/examples-critical-analysis>.

(Accessed 14 October 2019).





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Structuring the Literature Review



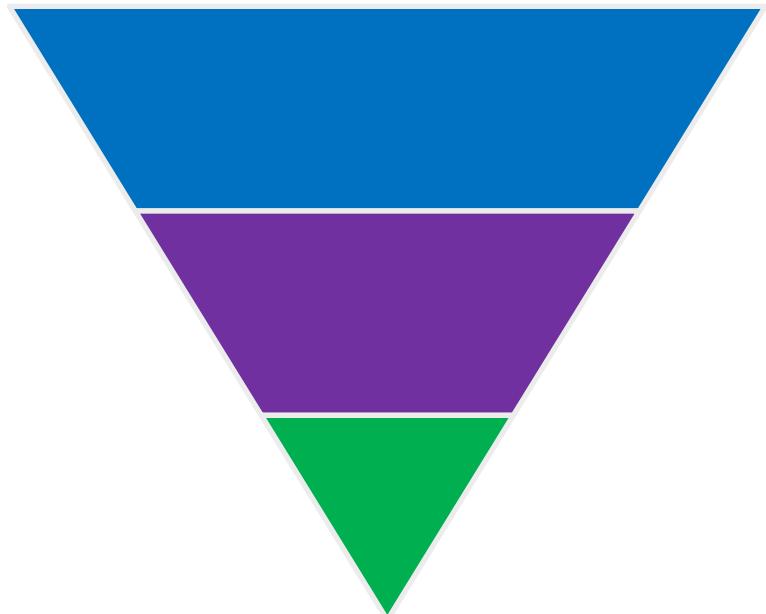
Thematic

- Distinct themes or subtopics may emerge as you read
- You may want to tackle these section by section
- Subheadings may be useful
- Don't forget to draw these separate themes together in your discussion that follows, and draw overall conclusions



Triangle

- You may want to think of your literature review as narrowing down to look at a particular issue or gap in research
- Here the review starts broad, perhaps with an overview of the context
- It then focuses in on more specific examples of research, or a more niche area of your topic



Wheel

- This structure might be useful if there are various approaches to understanding your topic
- Your subject is the ‘centre’ of the wheel
- You might discuss different theories, approaches or methodologies that apply to this topic, but are themselves dissimilar and separate



An Intrusion Detection Scheme for Identifying Known and Unknown Web Attacks (I-WEB)

Chapter 2 Literature Review.....	8
2.1 Introduction	8
2.2 Web Attacks	8
2.3 Intrusion Detection System	11
2.3.1 Types of IDS	12
2.3.2 IDS Detection Methods	12
2.3.2.1 Misuse Based Detection System (MBDS)	12
2.3.2.2 Anomaly Based Detection System (ABDS)	13
2.3.3 IDS Datasets.....	15
2.4 Pre-processing Phase	16
2.4.1 Feature Selection.....	16
2.4.1.1 Filter and Wrapper Methods	17
2.4.2 Summary	21



Paragraph structure

1

- **Introduce** your point

2

- **Elaborate** on your point

3

- **Evidence** your points with sources

4

- **Comment** on the evidence

5

- **Conclude** your point



The highest proportion of “unknown” attacks each year has emphasised the serious need for defence mechanisms. The unknown attack is generally known as a zero-day attack in the network security field (Levy, 2004). The persistent growth of vulnerability and threats has also emphasised the serious need for defence mechanisms. The main technology of network security focuses on access control, firewall and information encryption. However, it is also important to acknowledge the common issues related to bugs and deficiencies. For instance, a firewall alone is unable to detect intrusions occurring from within the network (Wankhade and Chatur, 2014). This further explains why the intrusion detection system (IDS) has become a popular option. In addition, IDS is recognised as one of the components in the security arsenal as “defense in depth” (Northcutt et al., 2008), **that acts as a complement to the existing security appliances**. Although the IDS does not guarantee the security aspect, it will be greatly enhanced if integrated with other security measures, such as vulnerability assessments, data encryption, user authentication, access control, and firewalls.

Kamarudin, Maple and Watson (2019)



The given-new principle

- Formulated by Michael Halliday (1967).
- Write known (given) information before unknown (new) information.



Feature selection process has attracted interest of many researchers due to its potentiality in reducing high dimensional data. **Feature ranking algorithm** was introduced merely to select the top six features based on rank (Sung and Mukkamala, 2004). **The authors** used three ranking algorithms of support vector machines (SVMs), multivariate adaptive regression splines (MARS), and linear genetic programming (LGP). **The algorithm** would select the best feature and make performance comparison between each algorithm. **The algorithm** would be programmed to detect Probe and DoS attack.

Adapted from Kamarudin, Maple and Watson (2019)



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The algorithm would be programmed to detect Probe and DoS attack.



Methodology



Methods

- Describe how the study will be carried out, **justifying** how the methods you have chosen will address your objectives
- Your approach needs to be feasible and appropriate
- Discuss the strengths and shortcomings of your approach. Are there any issues or weaknesses that you anticipate?
- Provide references to similar pieces of research where necessary to justify your approach

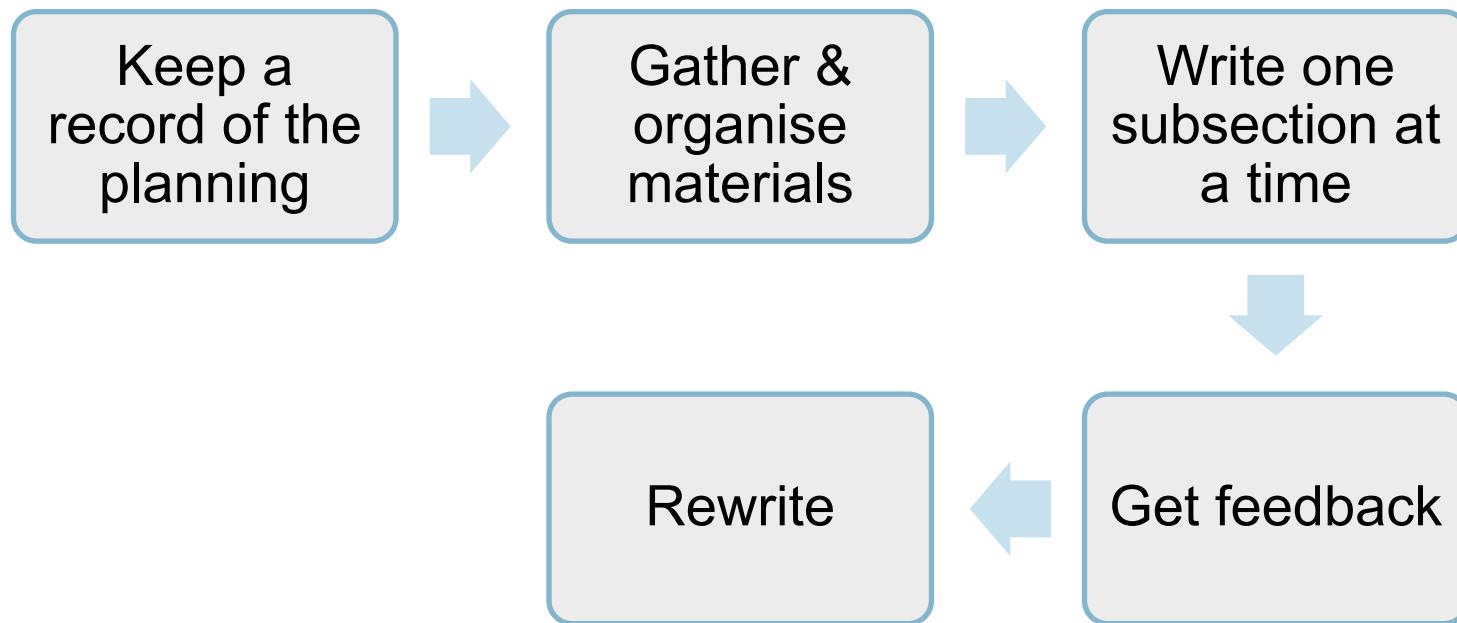


Methodology section

- Explain **how** the study will be conducted.
- Justify your choice and methods.
- Provide enough detail to allow interpretation and evaluation of your results.



The flow



Structure

- Varies depending on the focus of your research
 - Analysis and Specification
 - Design
 - Implementation and testing
 - User interface
 - Project management



- Analysis and Specification.** How you analysed the problem, including user requirements. Give an appropriate specification of the solution. For projects involving software development you may include a formal Software Requirements Specification in an Appendix.
- Design** If it is a software development project then give a high-level account of the structure of your software and how it works. What algorithms does it use? How do these compare with alternatives? What were the main design decisions you took, and their justifications?
- Implementation and testing** A detailed account of the implementation and testing of your software. Explain the conceptual structure of the algorithms. Also explain what data structures you used, and how the algorithms were implemented. What implementation decisions did you take, and why? There is no need to list every little function and procedure and explain its working in elaborate detail; use your judgement on what is appropriate to include. Explain your testing strategy and provide convincing examples of tests. In project involving software development it is usual to relate the tests to your Software Requirements Specification.
- User interface** If the interface forms a substantial part of your project (e.g. an HCI project), you will wish to include quite a lot of detail and explanation. In other projects the interface may be less of an important focus.
- Project management** How have you managed your project and the writing of a substantial piece of software? Discuss the appropriateness of your methods in the light of your experience on the project.



Developing a cross-platform 2D game, Windows, Linux, macOS, Android

4 Project Specification.....
4.1 Project Overview
4.2 Requirements
4.3 Tools Used
4.3.1 Why Java.....
4.3.2 LibGDX
4.3.3 Other Tools.....
5 Game Design and Implementation.....
5.1 Level Design.....
5.2 Art Design
5.3 System Overview
5.4 The Game Loop
5.4.1 LibGDX Application Life Cycle
5.5 Physics with Box2D
5.5.1 Introduction to Box2D
6 Evaluation.....
6.1 Testing
6.2 Evaluation by Potential Users
6.2.1 Distributing the Game to Users
6.2.2 Evaluating Usability.....
6.2.3 Analysing Survey Results



Creating an algorithm to identify styles of breach

4 Formulation Of The Solution
4.1 Algorithm Design
4.1.1 Input
4.1.2 Overview
4.1.3 Segmentation
4.1.4 Feature Extraction
4.1.5 Comparator Formatting
4.1.6 Classification
4.1.7 Output
5 System Specification And Design
5.1 Data Assumptions
5.2 Requirements
5.2.1 Functional
5.2.2 Non-Functional
5.3 Style Breach Detector Product
5.3.1 Pipeline
5.4 Evaluation File
6 Implementation And Testing
6.1 Implementing The Algorithm
6.2 Optimisation And Analysis
6.3 Testing
7 Project Management
8 Experiments, Results And Evaluation
8.1 Evaluation Criteria
8.2 Data Splitting For Training, Validation And Testing
8.3 Deciding On Optimum Segment Minimum And Maximum Length
8.4 Deciding On A Metric To Compare Segments
8.5 SVM: Complexity And Class Regularisation
8.5.1 Precision and recall
8.5.2 Class Regularisation
8.6 Final Model



3	Design	
3.1	Synthetic features
4	Experimental setup	
4.1	Adversarial Robustness
4.2	Synthetic features
↑		
A study on the limits of adversarial examples in machine learning		
Epileptic seizure prediction in Intracranial EEG recordings using deep learning		
↗		
4	Data Collection and Preprocessing	
4.1	Dataset
4.2	Data Collection
4.3	Preprocessing
4.4	Variable Number of Channels
4.5	Signal Denoising
4.6	Data Augmentation
5	Designing the network	
5.1	Layer Types
5.2	Number of Layers and Units
5.3	Training parameters
6	Ensemble Model	
6.1	Random Forest
6.2	Logistic Regression
6.3	Ensemble



Conclusion

- **Beneficiaries** of the study are specified.
- Proposal spells out **expected outcomes** with supporting reasoning

- Explain the **implications** that your study will have for your chosen targets (e.g. human health, biodiversity, adding to important scientific knowledge, etc.).
- Use reasoning/evidence to support these claims where you can
- Reiterate what you hope to have found
- How will this have added to the field?



Summary



- A literature review provides an overview of the topic but it also situates your research within the field of study.
- Choose a structure to your LR that allows you to most effectively synthesise the research.
- Take a critical approach to reading and writing.
- Remember that you should critique the research in relation to your research questions and findings.
- Record all the processes for methodology section.



Any questions?

Happy to answer any
questions or clarify any
of the information I've
talked through



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asc@contacts.bham.ac.uk

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<https://intranet.birmingham.ac.uk/asc>

The screenshot shows the University of Birmingham Academic Skills Gateway intranet page. At the top, there's a purple header bar with the university logo, the text 'UNIVERSITY OF BIRMINGHAM INTRANET', and links for 'Main website', 'Login', 'For students', 'For staff', and a search icon. Below the header, the URL 'University of Birmingham Intranet > Academic Services > Library Services > Academic Skills Centre > ASC Gateway' is visible. The main title 'Academic Skills Gateway' is centered above a yellow banner with the text 'ACADEMIC SKILLS GATEWAY'. Below the banner, there are six categories arranged in a 2x3 grid, each represented by a purple gear icon containing a white illustration related to the skill:

- Reading and note-taking**: A book icon.
- Writing and critical thinking**: A notepad and pen icon.
- Using library resources**: A computer monitor icon.
- Referencing**: A stack of books icon.
- Exams and revision**: A document icon.
- Using feedback**: A smiley face icon.

Below the grid, there's a decorative illustration of the University of Birmingham campus skyline.