Research project thesis and presentation guidelines

MSc Bioinformatics and Systems Biology

Research Project Thesis

Writing your Thesis

Be sure to start writing your thesis early in your project. You should include this in your Project Plan. Do not be afraid to waste time writing things down that you may need to change again afterwards; this is unavoidable and a natural part of the writing process. This means that after, e.g., background reading you can immediately write most of your introduction, after program design and script writing you can write most of your methods section. Most students need 3-4 weeks to write down a first full draft of their thesis, after finishing their last results. Make sure to check the rubrics before, during and after you write your thesis.

How to get started?

Most students find it easiest to start writing the **methods** section. It is very wise to carefully document the methodology while you are developing it, and if you write it down formally you can also get better feedback from your supervisors. Some students start writing the **introduction** early on, however, if your research question changes during the project you may need to rewrite your introduction somewhat. It is wise to keep a set of notes from all the literature you read, so that it is easy to write this out in a full introduction at a later stage. After writing the methods, you should typically outline your **results**, choose the figures for your results and write an **abstract**. Make sure your abstract gets checked carefully by your supervisor, this will make sure you will focus on the right contents in your thesis. This is also a good way to get initial feedback on your writing style. Finally you write the **discussion** and finalize the **introduction.** Make sure to connect your research to other research in the introduction and discussion explicitly by citing these works. Check the **Grading Rubrics** before you start writing. These give you a good idea of what is expected of you.

Importantly, involve your supervisors (certainly your daily supervisor) in the writing process. Start with only a draft outline to structure the story, and add the sections one by one. Ask for feedback at each step. The best way to understand what is expected of you in a project thesis, is to read finished and graded theses from other students.

Thesis style and length

Your thesis should be written in the format of an academic article. The main text (excluding title page and references) should be no longer than 3 pages (double-column) per month (6 EC), or 2500 words per month with 1-2 figures per month (6 EC); note that it may be shorter.

Discuss with your supervisor if they are intending to submit your work to a specific journal or conference. If there is a good reason to choose a slightly different length or format this should be discussed and agreed with both your examiner and supervisor.

You can add additional figures and information as additional evidence in the Supplemental Information (SI), but the main text should be understandable without consulting the SI. You should refer to the SI from the main text.

Sections of the Thesis

The thesis should contain the following sections:

- Title page
    - your **name** and **VU student number**
    - **the title** of your thesis
    - the names of your **supervisor** and daily supervisors
    - the name of your **examiner**
    - the **course ID** and name (minor or major research project),
    - the number of **credit points** (18-30 for the minor, and 30-42 for the major).
    - Also clearly indicate on the title page if your thesis is **confidential** in a large font.
- Abstract
    - this is a summary of the work
    - maximum of 300 words
    - you should describe:
        - the research question
        - the background of the research
        - obtained results
        - the potential impact of the research on society and/or other research
    - see for example this Nature example
- Introduction
    - including a motivation: why is your work important?
    - Start broad and narrow it down towards the research question
    - State the research question explicitly
    - Both the biological research question, as prior methodology that is similar should be introduced
        - You need give an overview and cite relevant earlier work with respect to both of these.
- Methods
    - The first aim of the methods should be that another researcher (think MSc student) can reproduce you work
    - Be very precise and specific in the methods
    - Nethertheless, try to explain why you make certain choices in the methodology

- Results
    - Here you should show the evidence answering your research question.
    - The results need to be present by showing the data using figures and tables.
    - The results also need to be stated in the main text.
    - The results are typically structured around strategically chosen figures and tables that represent your data and outcomes.
    - You can briefly reflect if the results follow expectations, speculations should go into the discussion.
- Discussion
    - This should be centred around comparing your results to other research
    - You need to cite other work, and compare this to your results.
    - In addition you can make recommendations for future research in the same direction, and highlight any unresolved problems or uncertainties in your data
    - No new results can be presented.
- Conclusions
    - No new facts!
    - Can in some cases be combined with the discussion. In this case, the conclusions (answering your research question) should be the first one or two paragraphs of the discussion.
- Acknowledgements
    - Scientific work is never performed in isolation. This means you must acknowledge when and where you have been helped by others, which other work you have been building on, etc.
- Availability
    - Explain where the data, scripts and protocols are stored.
    - If possible, provide a link to the repositories, otherwise provide a contact person.
- References
    - citations in the text as (Author, Year)
    - all items in the reference list must be cited in the main text.

Figures & Tables

- Your thesis should include at least one table *and* one figure, with a general guideline of 1-2 figures per 6EC.
- All tables and figures must have a number, a caption with a title (in bold) and must be referred to in the main text.
- Figures and Table should be included (typeset) within the relevant section as close as possible to its first reference. They should not be put at the end of the document.
- Make sure to give a caption with each figure and table that ensures you can read the figure independent of the main text. The title of the figure should summarize the main point of the figure.
- Make sure to give variable names AND (SI) units along the axes of your figures. Make sure the caption explains the axes.
- Tips on how to make good data visualizations can be found at: https://serialmentor.com/dataviz/index.html

Writing Style

The style of your thesis should be similar to that of a scientific paper, see for example articles in PLoS Computational Biology (Links to an external site.) or Bioinformatics (Links to an external site.). Anything that you include that is based on other people's work, like ideas, algorithms, methods, needs a reference. In general, you should never copy anything (phrases, figures, tables, data) directly from any other work, but if this is unavoidable, it is only acceptable if it is clearly stated as being copied, and from where it was copied with permission from ... a reference. For example, you might write 'In [34], protein interactions are defined as "two protein molecules that are in physical contact in a stably bound complex" '. Or, 'This figure was taken from the Wiki page on protein-protein interactions (https://en.wikipedia.org/wiki/Protein–protein_interaction (Links to an external site.))'.

Layout

We do not impose strict layout rules, but there are a few guidelines:

- include a title page with Title, (all) author(s), clearly indicating your daily supervisor(s) and VU/UvA supervisor. You also need to include your student number, credits, duration, course, code the MSc you are enrolled in and your chosen track / specialisation. Also the institute, department and group where the work was carried out should be mentioned on the title page.
- Be sure to **use page numbers**
- Be consistent, esp. in layout of figures and tables
- Choose a clear formatting of chapter, section and subsection headings (again, be consistent).
- deliver the thesis as PDF to your examiner (any closed document format such as MS Word will not be acceptable).

Code, Data and Protocols

- Should be given in an (electronic) appendix or link to a github/bitbucket/gitlab repository, or data repository.
- Should also be described in the "Methods" sections of your thesis
- All code should
    - be split into modules
    - contain comments
    - only have easy to understand variable names
- other students should be able to modify the code without problem

Discuss with your supervisor(s) what should be done with data produced during the project. In general, it should typically be archived (i.e., put in an archive file and/or on a repository like github, and submitted as an appendix to your thesis). Your project supervisor will assess if you have handed over your code, data and protocols in an appropriate manner.

Final Presentation and Defense

The final presentation

The best way to know what is expected of you in a scientific presentation is to attend some presentations of fellow students. For a detailed overview of how your presentation will be graded you can consult the Grading Rubric.

- The presentation should be 20 minutes (with **no more than 20 slides**). Going over time or having too many slides will result in downgrading.
- You should give your presentation twice:
    - Once in the group / institute / company where you performed your research. This presentation will be graded by your supervisor. You should ask for feedback after this presentation.
    - Once for your examiner, this is your final presentation and thesis defense.
- You should pitch your presentation at fellow students, having followed the compulsory bioinformatics courses
- In general, each slide should make one key point.
    - it needs at least one figure to make this point clear
    - the key points should also be in the text of the slide (for example in the title)
- Avoid text-only or Figure only slides
- If you show equations, make sure to explain them properly (term by term) - or write them on the (black/white) board
- If you show a plot, make sure to explain it (what is on each axis, what does the plot tell us)
- Show your slides to your supervisor or your examiner before you give the presentation. Ask for feedback on your slides, and do this well ahead of time so you actually have time to process the feedback
- If possible, give a practice talk to some of your fellow students, you can ask them to give you feedback based on the rubrics.
- You do not need to show all aspects of your research project in the presentation. Typically you will not have time for this. Show those results you think are most important. You can prepare additional slides for the discussion during the defense - in case you get asked questions on topics you have not been able to cover in the given time.

The structure of a final presentation is typically as follows:

- Introduction + motivation (at least 3 slides)
    - include the research question explicitly
    - explain why this is an important research question (put the research in context)
- Methods (sometimes these can be combined or alternated with the results)
- Analysis, Results and Discussion
- Conclusion
- Acknowledgements

Thesis defense

At the end of your presentation your examiner and other people in the audience will ask you some questions about your research. Note that the examiner may also ask you some questions about topics that you covered in your thesis, but not in your presentation. Make sure to read your thesis again, just before your defense. You can look at the grading rubrics to see on which points the examiner will try to assess you. These points are listed under "Research Competence" in the grading rubric. It is important to listen carefully to what is being asked. It helps if you rephrase the question in your own words, before answering the question; this allows the asker to check if you understood the question and also gives you some time to think.