Thesis Guidelines for students:

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Before the supervision starts

Students have access to general information page which outlines the Thesis inforrmation Please note, the matching procedure is shared on the general information page too. The thesis matching is done centrally by the thesis coordinator, taking into account the requests of students and supervisors when feasible as described in the aforementioned page. Every semester, a thesis information session for the upcoming semester is organized by the study advisors of the program.

Example timeline

May 11 2023	Thesis info session
2021-06-01	Info released to students
June 21 - Friday June 30	Students can pitch a project
June 30-July 10 th	Supervisors can request up to 3 students directly. (file will be made available to supervisors)
2010-07-01	Deadline student matching survey

2019-07-01	Tentative matching will be shared on canvas general info page
2023-08-28	Start of Thesis supervision
2023-09-25	Assignment Thesis Proposal Draft - Formative assessment deadline
2023-10-09	Assignment Thesis Proposal deadline
Mon, 23 Oct 2023	Assignment Thesis Proposal (Resit)
2023-11-02	Poster Presentation event placeholder10:00 to 16:00
2023-11-03	Assignment Poster Presentationdue
2023-11-06	Go-No Go Moment
2023-12-04	First Submission opportunity for the final deliverables
2023-12-22	Grades for the first attempt are posted
2024-01-15	Second Submission opportunity for the final deliverables

Syllabus

Aims Learning Goals and Content

After completing the bachelor thesis project, the students will have obtained experience with all the phases of empirical quantitative research in cognitive science and artificial intelligence. They will have applied the knowledge and skills acquired in different courses.

The l**earning goals** are defined as follows:

Carry out scientific research in the combined domain of cognitive science and artificial intelligence under supervision and evaluate its merits;
Create programming code either for the purposes of new software or for data analysis and/or representation, in line with best practices and coding standards;
Report orally on the scientific and social-cultural merit of their project;
Write an academic report on the research;
Create a short video demonstration of the outcome of the project.

Content

The purpose of the Cognitive Science and Artificial Intelligence bachelor projects is for the students to conduct, under supervision, a quantitative research study in the fields of cognitive science or artificial intelligence. Students are expected to approach

the problems and questions pertaining to their project with curiosity, creativity, in an analytical manner, and as analytical thinkers. In order to formulate an appropriate research goal, students will actively develop in-depth knowledge about a specific application area that will be discussed in the theoretical background for their thesis.

The first stage in the project should result in a well-crafted individual thesis proposal that provides the evaluating staff members with a clear view on the feasibility of the project. The thesis proposal is presented both in writing and orally during a poster presentation round organized by the examiners. If the thesis proposal is successful (receives a "pass"), students continue with the actual research. The final product of the Bachelor Thesis project is a written report, accompanied with the programming code created for the purposes of the project and a short demonstrator video. The final product is evaluated with a grade by the supervisor of the project (first reader) and an independent examiner (second reader).

Documentation

All documentation (including for the thesis, the proposal, the presentation, and the poster session) will be available in the Modules link to the left.

Requirements

The standard requirement to start a Bachelor thesis for the CSAI program is to complete 120 ECTS. To start a thesis in fall requires having completed 150 ECTs.

Deliverables and steps in the assessment

Project Proposal

The project proposal is the first opportunity for students to present their project and deliverables, including a literature review of scientific articles relevant to the content of the project. The project proposal is evaluated with a pass/fail and constitutes an instance of a summative assessment.

Poster Presentation

The poster presentation is the second opportunity for students to present their project. The poster presentation consists of a short oral presentation (maximum 5 minutes), a demo (where applicable) and/or a video and a poster. All students present their projects to scientific staff members and other students in an exhibition-like setting. If applicable, students should process the feedback given by the examiner (the supervisor of the thesis cluster in which the student is conducting the project), other lecturers and peers in the final deliverables handed at the end of the project. The poster presentation constitutes an instance of summative assessment and is evaluated by a pass/fail by the examiner.

The student must have a passing grade from the poster presentation and the proposal assignment to submit the final deliverables.

Since all assignments are mandatory, failing on the proposal or the presentation will stop the thesis process. These two assignments are not dependent on each other in

terms of timeline; the grade of the proposal might not yet be determined before the presentation event.

Final Deliverables

For the thesis project to be evaluated, the following deliverables are required:

- A written report including a reflection on the student's development (further information can be found in the Bachelor Thesis Guidelines);
- The programming code created in the context of the project (e.g., R code for conducting statistical analyses and visualizations, Python code for machine learning or Unity code for VR applications);
- A demonstrator (short 2-minute video describing the content and outcomes of the project).
- A self reflection essay

The final deliverables are assessed by the first and the second examiner independently and in line with the Exam Rules and Regulations. This evaluation constitutes a summative assessment and results in a final verdict which is communicated to the student within 15 days after handing in the final deliverables. The first examiner carries the main responsibility for the judgment and the quality of the assessment. The second examiner is there to assure that a fair and sound verdict is reached.

The first examiner delivers the result to the Educational Office, where they will record the grade in the TiU education information system (OSIRIS).

Students have the right of inspection and should be notified of this right by their examiner. Consequently, students can request a meeting with the examiner to clarify the arguments for their grade.

Grading

All the deliverables of the thesis course except the thesis report are pass / fail assignments. They are all mandatory. So the student should have a passing grade for the proposal, presentation and then from all the final deliverables: code, self reflection essay, thesis report and demonstrator.

There is a rubric for each graded assignment. For the pass/ fail assignments, there are several criteria in the corresponding rubrics, and one has to have a passing grade for each criterion. The pass for each criterion is indicated by sufficient (no partial points are possible, it can be an insufficient for fail or sufficient). That concerns all the deliverables other than the report which has a point grade assigned per criteria (not pass /fail)

The point grade of your thesis is determined by the thesis report.

Both readers provide independent evaluation of the thesis report and the first reader provides the joint grade for the thesis. A component has a passing grade only of both readers grades it with a passing grade.

The grade of the thesis report is a pass if all component (joint from both readers, what you see in Canvas) grades are a pass (6 or more). In that case it is calculated by taking the average of the component grades.

Timeline

Please see the calendar, and the bottom of this page.

Please be aware, the regular supervision meetings end with the first submission deadline.

The students will be given feedback for their first attempt and can use this to improve their work for the second submission.

The deadlines are strict and for fairness purposes, we do not deviate from them on individual basis unless there is a valid reason delaying student's work.

For personal circumstances that delay your thesis work, contact your study advisor as soon as possible, do not wait till last minute, or till you figure out you will not meet the deadline. Processing of any request will take time which is not ideal for you.

Frequently asked questions

- Who should I talk to if I having a question or a problem that isn't answered on this list?
    - A question about a personal issue, your study advisor: Suzanne Warmerdam
    - Your study advisor is a great first stop for nearly all questions, she can point you in the right direction about who can help given your situation.
    - A question or issue with the Bachelor thesis procedures: Dr. Çiçek Güven (bsc-csai-thesis@tilburguniversity.edu) If you prefer a meeting, send an e-mail to schedule one in office hours.
    - A question or issue with the Bachelor program as a whole: Dr. Emmanuel Keuleers
- What happens if I do not pass my thesis proposal?
    - If your thesis proposal does not receive a passing evaluation, then you will have to restart with a new thesis topic in one of the next offerings of the course.
- What happens if I am not able to finish my thesis or get a passing grade by the second submission deadline this semester?
    - You will need to enroll via Osiris in the Bachelor Thesis course in one of the next offerings of the course. If this happens, you

should discuss your situation with your current supervisor and Dr. Güven. You will then need to work on a new thesis topic when you restart the thesis. (You should comply with the requirements listed above to start on your thesis for the semester you want to work on the thesis; Fall and Spring semesters have different requirements)

- When you restart, you will need to go through the whole matching process again which is communicated in the general information page (for eery offering of the course this is done in the preceding semester, check the general information page for the announcements regarding the matching. The students that are working on their thesis whose grades are not determined in the usual timeline should fill in the survey for the upcoming semester.
- Is it possible to get an extension for working on my thesis?
    - In case of unforeseen circumstances preventing timely submission of the thesis, students should contact their supervisor. The supervisor will consult with the study advisor and the thesis coordinator to decide whether an extension should be granted.
- For the final thesis evaluation, does the failing or passing depend on the average of all components?
    - For a student who submitted a thesis, their grade for all individual components should be a passing grade (that is 6) for them to pass (each criteria (for example form and presentation) should have a passing grade from both readers).
    - There are also deliverables with a pass/fail grade. The student should have a sufficient grade for all the final deliverables to pass from the course, that is, a 6 from the report and pass from all other deliverables. For a fall fail components, that requires all criteria to be graded with a pass grade.
- Can I work in the same thesis topic if I take the course twice?
    - This is only possible when your supervisor agrees and when you did not make a thesis report attempt.
    - In case a proposal is submitted: the student must clearly mark that this was a proposal that was previously submitted, i.e. refer to their earlier work.
- In case I am doing an external thesis, can my supervisor or thesis coordinator sign contracts from the third party?
    - Faculty members do not sign such contracts. Please consult with the internship coordinator. This has to be done timely, since there are generic agreements that the university prefers to use, any non-generic contract has to go through legal department, which might take long, and not feasible given the number of thesis students. That is why, we only allow students to do

external thesis with companies when the company agrees to use the standard agreements (such as NUFFIC).

- How are the internship course and the thesis course are related?

  A student who does an internship with an internal supervisor or external company might be willing to continue collaborating with that party in their thesis project (or vice versa). Students must be aware, having this project does not necessarily guarantee being matched with the same supervisor for the thesis later on. The student has to go through the same matching process as others. Students can pitch to faculty members and supervisors can list a number of names for each semester to supervise students. When they have availability, they can include the student in that list if they are willing to supervise them.

  The internship reports will be in the Turnitin archive and the thesis will be checked for overlap. The students should cite their own internship report, do not recycle parts of the report in the thesis; the students should simply treat their work as work by other any other author in terms of citing, quoting and overlap. Otherwise, there is risk of self plagiarism. Hence, the distinction from the internship report must be highlighted in the thesis report. It is the responsibility of the supervisor to guide the student in that respect. The expected novelty level for such a thesis is the same as any other thesis. Taking all these risks into account, we advise the students not to take this path and work with other supervisors, companies.

- Can I see previous thesis examples?
  - See here.
- Where can I find information about Tuition fees in case of a graduation delay?
  - This is a general question. There is a webpage about tuition fees and payment and registration (see below). It may help but sometimes the questions are very specific and then students can always contact their study advisor. Thesis coordinators are not the point of contact for financial matters.

Tuition fees and payment | Tilburg University Registration at Tilburg University

Academic Writing

Scriptorium: guidance for academic writing

When working on a paper or your thesis, the scriptorium provides a fresh perspective on your text. Moreover, they can help you with the writing process.

The scriptorium services are free for all Tilburg University students writing in English or Dutch.

Make an appointment in two steps:

1) Ask for permission by sending an email to the program coordinator, Marion van Heijningen.

2) Fill in the form on the scriptorium website: click here

Thesis Guidelines are shared over the current edition of the course as pages under modules with students

Practical supervision information for students

This section includes some general reminders to begin with.

BSc thesis supervisors provide group supervision. The supervision meetings are expected to end with the first submission deadline.

Supervisors might have some differences in their supervision style but the deliverables and timeline and requirements are the same for all students working on their thesis.

Group meetings allow practical questions to be answered more efficiently, also allow students to see the progress of their peers.

Students are expected to come to meetings, and to be prepared.

In general, supervisors do not schedule individual meetings with thesis students, unless the circumstances are exceptional, and this is up to the supervisor.

Students get feedback on their progress in different ways. Some examples of these are below:

- Supervisors provide formal feedback on the thesis proposal document.
- Supervisors provide an evaluation along the rubric criteria and a motivation for the grade for each formal submission of a thesis.
- The feedback on the thesis report has grade justification purposes, should not be treated as a list of checkpoints to guarantee an increase to a higher grade.

- During group meetings, potential research questions, methods, and how to frame questions within a literature can be discussed.
- Supervisors are not expected to review drafts of your thesis and provide comments. Students have two attempts to submit their thesis and get formal evaluations. Students are encouraged to make both attempts as these are the opportunities to get evaluations of their full thesis.

- Students can take the initiative and ask to present outline of chapters, the supervisor may discuss if they are appropriate or if anything seems to be an issue.

- Students can take the initiative and send one page of what they believe is finalised text and supervisors may give them feedback if they see any major issues in the student's writing that may be an issue for their thesis.

Ethical Standards compliance for students

With the advent of AI-powered technologies that can assist in writing text, the assessment policy of the Bachelor Thesis CSAI has been updated to include the requirement for a **Statement of Technology** to be added to all deliverables. In the final thesis, this statement will be part of the broader **Data Source/Ethics/Code/Technology (DSECT)** paragraph. The templates will be updated to reflect the latest version of the Ethical Standards Compliance document for Students

Information about data collection: student research with human participants

Dear students, if you are willing to collect data for your thesis, please see here under Research by BA/MA students.
There you can find a flowchart regarding "Evaluation procedure student research with human participants" and a checklist for your supervisor.

The statement below is from the listed website.

To determine whether the REDC can evaluate student research projects, supervisors can use this flowchart .
"The REDC expects that both supervisor and student adhere to responsible research practices, and encourages ethical reflection, data management, and GDPR compliance to be part of the supervision. Therefore, the REDC does in principle not review student research, as this is regarded as a shared responsibility of student and supervisor. Supervisors can use this checklist to evaluate student projects.

- There are two exceptions:
    - The student's research is part of the research line of the supervisor.

        - The supervisor and student intent to publish the student's research in a journal that requires ethical clearance of the student's research.
    - If one of the two criteria stated above are met, the supervisor and student can apply through *G.E.D. Started!*
    - Approval cannot be obtained after a study has been started or conducted.

More information on data management and handling personal data in the context of student research can be found through this handout or this libguide ."

How is the grade determined?

All the deliverables of the thesis course except the thesis report are pass / fail assignments. They are all mandatory. So the student should have a passing grade for the proposal, presentation and then from all the final deliverables: code, self reflection essay, thesis report and demonstrator.

There is a rubric for each graded assignment. For the pass/ fail assignments, there are several criteria in the corresponding rubrics, and one has to have a passing grade for each criterion. The pass for each criterion is indicated by sufficient (no partial points are possible, it can be insufficient and sufficient). That concerns all the deliverables other than the report which has a point grade assigned per criteria (not pass /fail)

The student must have a passing grade from the poster presentation and the proposal assignment to submit the final deliverables.

Since all assignments are mandatory, failing on the proposal or the presentation will stop the thesis process. These two assignments are not dependent on each other in terms of timeline; the grade of the proposal might not yet be determined before the presentation event.

For the thesis proposal, a submitted proposal might be discussed before the grade is released during supervision, which might indicate the failing /passing process of the proposal.

The point grade of your thesis is determined by the thesis report.

Both readers provide independent evaluation of the thesis report and the first reader provides the joint grade for the thesis as well as grade justifications consolidated from two readers. **A component has a passing grade only of both readers grades it with a passing grade.**

The grade of the thesis report is a pass if all component (joint from both readers) grades are a pass (6 or more). In that case it is calculated by taking the average of the component grades.

For the thesis for all deliverables, the higher-grade counts among two submission opportunities. This is on the assignment level (report, video, self reflection essay and code).

You only have to resubmit the deliverables you have failed on.
If the code is a pass, your grade will be taken into account even if you make a second submission. A second submission is not obligatory after a passing code component, but if you do substantial changes to your code, it is recommended.

All the grades and feedback for the two thesis submission opportunities will be released at the same time for al students, on the date determined on the timeline.

The thesis grade will be in Osiris in 10 scale. Canvas displays the component sums hence a sum over 60 is displayed. It does not automatically round the grade to a failing grade represented by 30, when a criteria is a fail. When a criteria is graded with a failing grade, the thesis fails, or when one of the deliverables is graded with a failing grade the thesis fails (represented by 5).

Frequently asked questions about plagiarism

1. What is plagiarism?

Tilburg University defines plagiarism as *"using parts of a text written by someone else, or the reasoning or ideas of others, for a thesis or other assignment, without due acknowledgement*". There are different ways to acknowledge someone else's work and ideas without committing plagiarism, such as citations and paraphrasing.

2. Where can I find information on how the university and my program deal with plagiarism?

- On the university's page on Fraud, cheating and plagiarism.
- In the rules and regulations of the school, in particular articles 15 and 16.

3. Should I only worry about plagiarism in written assignments?

No, the rules regarding plagiarism apply to any assignment (written or oral). Keep in mind that plagiarism applies when you use someone else's words, but also when you present someone else's ideas and reasoning as your own. Therefore, whenever you are presenting ideas or reasoning that are not originally yours in an academic setting, you should refer to the original source.

4. Is plagiarism limited to textual material?

No, plagiarism applies to any intellectual work created by others than yourself. For example, if you include (part of) a figure, table, or code produced by someone else in your work, then the original source must be added as reference. In some cases, such as figures, you may also need permission from the copyright holder to reproduce the material.

5. If I use synonyms when writing or presenting an idea or concept, is this enough to not be considered plagiarism of someone else's work?

No, in order to avoid plagiarism, students must explain ideas and concepts using their own words and in such a way that their own understanding of the topic is made clear. The use of synonyms does not achieve this. Rephrasing another author's idea using one's own words and structuring, is called paraphrasing. When paraphrasing, one should also refer to the original source of the concept or idea.

6. Do I always have to use a reference for any idea or concept that I did not create on my own?

No, there are ideas and concepts that are "common knowledge" and they do not need referencing when presented. For examples of *common knowledge*, please click here. However, this does not mean you can use someone else's presentation of that common knowledge.

7. Does is matter how much of my assignment/thesis is plagiarized?

No, once a lecturer suspects of plagiarism it is their duty to inform the Examination Board of this suspicion and an investigation procedure will be initiated.

8. Can I take ideas and concepts from non-scientific publications or from unpublished work without attribution?

No, plagiarism also applies to unpublished and non-scientific sources, including the work of other students.

9. Can I be sanctioned if I allow my work to be plagiarized?

Yes, students who make their exam or assignment available for other students to plagiarize can receive a sanction.

10. Am I obliged to inform the Examination Board if I know or suspect that another student has committed plagiarism?

Yes, students who possess evidence that other students committed fraud have the duty to report this to the Examination Board.

11. What if I committed plagiarism unintentionally? Does that make a difference?

No, plagiarism is never acceptable. When a lecturer suspects plagiarism, they must inform the Examination Board, which will conduct an investigation of the case and rule on the matter.

12. I committed plagiarism. What will happen to my grade?

If the Examination Board rules that you have committed plagiarism in an assignment or exam, the assignment or exam will be invalidated. No grade will be awarded to you. If the Examination Board rules that you have committed plagiarism in your thesis, a possible sanction is that you will have to start a completely new thesis. In some cases, the Examination Board may decide that you are allowed to take a resit for the exam or the thesis.

13. I have been referred to the Examination Board for plagiarism. What is the investigation procedure?

If the Examination Board has been informed of a possibility of plagiarism, they will start an administrative investigation of the matter. The lecturer will have provided the Examination Board with material leading to the suspicion. After examining the material, the Examination Board will ask the student and lecturer to gather more information. The student will have the opportunity to give their version of the facts. After the hearing the Examination Board will make a decision on the case.

14. What are the sanctions for plagiarism?

If plagiarism is established by the Examination Board, the submitted work is invalidated and thus not graded. The Board will then rule on the case, which may vary from a warning, to the exclusion of a one or more exams or assignment attempts for a given period of time (from three months to one year). The Examination Board can also propose to the Executive Board the definite termination of the enrollment in the program of the person concerned (see, Rules and Guidelines, article 16).

Theses examples from previous semesters

Below you can find some thesis examples.

- Sensorimotor cortex pattern analysis for MI-BCI prediction: http://arno.uvt.nl/show.cgi?fid=156938
- Deep Learning for personalized physical activity prediction based on step counts:http://arno.uvt.nl/show.cgi?fid=156949
- Unsupervised Learning on Graph: An application to metastasis prediction:http://arno.uvt.nl/show.cgi?fid=156941
- Form-to-Meaning Systematicity & Language Acquisition :http://arno.uvt.nl/show.cgi?fid=156946
- Lies between Lines: Predicting a Country's Corruption with Worldwide GDELT Data :http://arno.uvt.nl/show.cgi?fid=156755
- The Overview Effect in Virtual Reality: a comparison between young adults and children: http://arno.uvt.nl/show.cgi?fid=156955
- A comparison of Machine Learning approaches to speaker recognition with short Dutch utterances :http://arno.uvt.nl/show.cgi?fid=156735

Please check the in the library catalogue https://tilburguniversity.on.worldcat.org/discovery. for more examples.

Checklist for students for self assesment on the report

Checklist for the thesis for students:

This checklist is prepared for the students to guide them around the minimal requirements to pass the thesis report given the rubric. Make sure, you can respond positively to all the questions below.

Answering these questions is a self assessment exercise.

Criteria 1: Formulation goals, framework project

This criteria mostly concerns the introduction and the abstract.

- Is it clear what the goal of your project is?
- Is your research strategy clear?
- Do you provide an outline of your strategy?
- Do you have an abstract?
- Does the abstract summarise the research goal?
- Does the abstract summarise the findings of your study?

Criteria 2: Theoretical underpinnings, use of literature

This criteria mostly concerns the Literature review, background and corresponding references (Related work section of the thesis and cited work in that section)

- Is a list of relevant references extended beyond what possibly suggested by the supervisor provided?
- Are the references and the corresponding existing work and theories are discussed without serious errors?
- Does the discussion about the existing literature allows the reader to put this work in perspective, for example, by comparing and contrasting this work versus others?
- Are the similarities and differences between this work and others are clear?
- Are the recent examples from the literature present when relevant?
- Is the state of the art around this research is clear?

Criteria 3: Use of methods and processing data

This criteria mostly concerns the methods section of the thesis

- Are the Methods and analysis of information described well/ explained in a clear way?

- Are the methods appropriate for the research goal?
- Is the notation used through the text is consistent.?
- Did the student make sure the common knowledge is not presented in too much detail but the reader rather directed to a relevant resource?

Criteria 4: Results, reflection on results

This criteria mostly concerns the results section

- Are the weaknesses of the study listed transparently and clearly?
- Are the results complete?
- Are the results explained?
- Are the tables, figures explained well?

Criteria 5: Discussion and Conclusion

This criteria mostly concerns discussion and conclusion sections

- Are the conclusions linked to the research goals?
- Are the conclusions provide insight aver the results, beyond merely repeating them?

Criteria 6: Fluency of writing skills, form and presentation

This concerns the whole thesis

- Do the information provided are mostly in correct places leading to a good structured thesis?
- Do the level of detail mostly acceptable?
- Do the formulation of text mostly clear, coherent and interpretable?
- Did the student make sure, the thesis does not include any improperly paraphrased material, improper/incomplete citations or improper attribution of direct quotations (including unauthorised reuse of images)?
- Is the thesis aligned with the template or formatting requriements?
- Is the thesis almost completely free of grammatical errors, spelling errors, typos?
- Does the thesis include a Data/ethics/code statement?
- Is the thesis within the specified length limits?

Proposal guidelines

Last edit: September 6 2023

General

The project proposal is the first opportunity for students to present their project and deliverables, including a literature review of scientific articles relevant to the content of the project. The project proposal is evaluated with a pass/fail and constitutes an instance of a summative assessment.

The project proposal consists of at most 4 well-written pages (1.5 line spacing, font size 11, excluding the title page, references, tables, and figures). Submission details will be posted separately. You proposal will be reviewed by the intended supervisor of the project and, if necessary, a second reader. The proposals will be evaluated on clarity (is it clear what will be done in this project?) and completeness (Is the proposal well-thought out? Does it address all of the important aspects of the proposed project?). The proposals should be written in correct Academic English and adhere to the APA Style. Proposals with spelling, grammar and style mistakes will not be evaluated; instead, you will be asked to resubmit a corrected version.

Note that your project plan may need to be adapted as you learn more about the data. This is fine as long as your overall goal (the task you are addressing, the data set you are using) remains generally the same. Should your project change in a major way from what you proposed, you need to get an approval from your supervisor.

Important: On the title page, provide your full name, email address, student number, the name of your internal supervisor, and the contact information of your external supervisor, if applicable.

Outline and Contents

Project Definition

Provide a clear description of the problem you plan to address.

Motivation

Briefly explain why this problem is worth addressing, both from a practical/societal and scientific point of view.

Background

Provide a summary of what is known in the scientific literature about this problem. This should be based on at least 5 (preferably, more) relevant sources. These sources need to satisfy the following requirements: (1) recency (last 5 years-(there may be exceptions to this if the domain of interest did not have many recent publications, please consult with your supervisor (2) quality (published in scientific peer-reviewed journals or conference proceedings), and (3) usefulness (they should help you frame the theoretical background of your project). At this stage of your project, a full

literature review is not expected but it will be expected by the time of the final report.

Design Experiment or Dataset Description

Describe the design of your experiment or the dataset(s) that you will use in your project (size, format, accessibility). Provide rationale as to why you are choosing these data.

Instrumentation and Material

For experimental studies, which instruments and experimental material are you planning to use?

Statistics, Algorithms and Software

Describe which statistical analyses or data mining and machine learning algorithms and software you plan to use in your project. For data mining/machine learning algorithms, define how you will evaluate your results. For prediction problems (classification or regression), you will likely make use of standard techniques: Against what baseline methods will you compare your algorithm(s)? How do you plan to obtain ground-truth labeled data so that you can measure accuracy, precision, recall or some other metric? If you are planning to use unsupervised techniques, provide information of how the clustering algorithm will be tested.

Milestones and Plan

Sketch out what you think will be the major intermediate milestones that you will need to achieve. Give a general idea of your planning.

Avoiding Plagiarism

As with all assignments, you have to make sure that you do not commit plagiarism. Plagiarism is considered a serious case of fraud that, when suspected, will be reported to the Examination Board. Committing fraud can have serious consequences. At the minimum, when fraud is established by the Examination Board, the assignment is declared invalid and, in the case of a thesis, a new thesis will have to be written. Please see Article 16 of the Rules and Guidelines for TSHD for the procedure and sections in case of fraud. Note that TiU defines plagiarism as: "Using parts of a text written by someone else, or the reasoning or ideas of others, for a thesis or other assignment, without due acknowledgement." (Source: https://www.tilburguniversity.edu/students/studying/regulations/fraud/whatisplagiarism – this text contains a more elaborate explanation of what is plagiarism.)

Useful Resources:

- TSHD Education and Examination Regulations (EER), including the Rules and Regulations: https://www.tilburguniversity.edu/students/studying/regulations/eer/humanities Links to an external site.

Please study the rubric of the assignment.

A BSc thesis with an external party

Many students are interested in writing their thesis with an external party, often a company or a non-profit organization. Please note that, in addition to this documentation, a thesis information session is organized twice per year (for the upcoming semester).

Generally, we expect that the external party provides the necessary data (it should not be your job to collect the data) and regular supervision of the thesis project (including people with technical expertise). External partners need to be aware that an external thesis is significantly different from an internship: it is an **independent research project** and specifically the research questions and method plan should be actively shaped by the student based on their interests in conjunction with the external partner.

In general, we view external theses as high-risk, high-reward decisions by students: as a student with an external thesis, you will have to balance the external partner's motivation for the project with the scientific requirements of the thesis. This requires good coordination, managed by the student. As your internal supervisor likely does not have access to the data upfront, external theses are more likely than internally organized theses to run into problems along the way.

As a student, you can propose an external thesis project to a supervisor who has indicated they are open to proposal pitches. Some companies/organizations have a standing collaboration with one or more of our supervisors. Even after your thesis supervisor assignment, you can propose an external project. Only in the case of a severe mismatch between the project and the assigned supervisor, a different supervision arrangement will be sought.

In any case, external thesis projects will be provided with an internal supervisor and internal second reader. Importantly, the independence of the student project should be guaranteed (explicitly in the thesis proposal). That means that convincing assurances need to be in place that the external party will provide an adequate, existing dataset suitable for a CSAI thesis. The company should be providing clarification on the codebook or appropriate domain knowledge, but the implementation should be done by the student. An external thesis student is of course allowed to discuss their work/progress with their external supervisor or wider research environment, for example in a weekly group meeting.

Preparing for an external thesis project

If you are interested in organizing an external thesis, here is a list of good questions to ask your intended external collaborator about a potential external thesis:

- What level of supervision has the external partner committed to having in the thesis process?
- What research questions are you thinking of asking (these do not need to be final, but a general idea is very helpful)?

- What methods might you use to answer those questions?
- Why is this an interesting question (both for the external party but also from a societal relevance perspective)?
- Does your external partner already have the data ready to share with you?
- How is the data stored and formatted?
- Does the external partner act in compliance with the General Data Protection Regulation (GDPR)? Are there ethical concerns related to the data collection activities?
- What variables exist in the data and how are they coded?
- How many unique data entries does the dataset contain?
- How much data are they willing to make available to you for your thesis project?
- Are the variables and amount of data sufficient to address the research questions above?
- What restrictions does the external partner have about sharing the data?
- Does the external partner want any restrictions on the publication of the thesis results?

NDA/Confidentiality:

Some companies require an agreement to be signed for a thesis project. It is important to discuss this at **the beginning of the process**. There are different scenarios:

- No agreement needed: no action required on this matter
- Request for two-party agreement: student and company agree on different aspects of the graduation project. No involvement of University needed.*
    - Students (not supervisors) are allowed to sign the University-sanctioned 2-party NDA.
    - It can be found here: NDA Geheimhouding data.docx (in Dutch only) Download NDA Geheimhouding data.docx (in Dutch only) Download NDA Geheimhouding data.docx (in Dutch only)
- Request for three-party agreement: Tilburg University works with the template provided by the 'Universities of the Netherlands'.
    - This agreement covers confidentiality, intellectual property and right of disclosure
    - You can find the template here: Model Internship and Thesis Agreement TiU.docxDownload Model Internship and Thesis Agreement TiU.docx

If a company insists on using their own 3-party agreement, be aware that this will not be automatically co-signed by the University, and can cause delay and/or obstruction of the thesis project. **That is why, our policy is not allowing these pitches for the Bachelor CSAI thesis.**

*According to Dutch Law, non-EU students will always need to use a 3-party agreement because of the required study residence permit.

Please note that the academic staff is **not authorised** to sign on behalf of the University. You can send your request for signing the thesis agreement to Louise van Hoek at tshd.internship@tilburguniversity.edu. With this request you will need to provide proof that your thesis supervisor supports the thesis project.

The supervisors of external theses do not need to be provided with raw datasets; however, these datasets should be **available for inspection** by the internal supervisor if needed. The code should always be fully available to the supervisor. The intellectual property rights to the research/thesis results lies with the student (see also the 3-party agreement). The copyright to the research reports and the thesis lies with the student. Students can request the thesis **not** be indexed publicly by the library. External parties can request a publication embargo of in principle up to 2 years. However, the thesis should always remain available for purposes of re-accreditation of the Bachelor CSAI program for at least 7 years.

Thesis Report Guidelines Fall 2023

Version updated on September 6 2023

This is to present the guidelines around the content of the thesis report. Please also read other information/pages in the general information and guidelines module.

Let's first remember the objectives, learning goals and deliverables of the thesis project before providing the guidelines of the report:

Objectives

The purpose of the Cognitive Science and Artificial Intelligence bachelor projects is for the students to conduct, under supervision, a quantitative research study in the fields of cognitive science or artificial intelligence. Students are expected to approach the problems and questions pertaining to their project with curiosity, creativity, in an analytical manner, and as analytical thinkers. In order to formulate an appropriate research goal, students will actively develop in-depth knowledge about a specific application area that will be discussed in the theoretical background for their thesis. The first stage in the project should result in a well-crafted individual thesis proposal that provides the evaluating staff members with a clear view on the feasibility of the project. The thesis proposal is presented both in writing and orally during a poster presentation round organised by the examiners. If the thesis proposal and the poster presentation is successful (receives a “pass”), students continue with the actual research. The final product of the Bachelor Thesis project is a written report, accompanied with the programming code created for the purposes of the project and a short demonstrator video. The final product is evaluated with a grade by the supervisor of the project (first reader) and an independent examiner (second reader).

Learning Goals

After completing the bachelor thesis project, the students will have obtained experience with all the phases of empirical quantitative research in cognitive science and artificial intelligence. They will have applied the knowledge and skills acquired in different courses. The learning goals are defined as follows:

- Carry out scientific research in the combined domain of cognitive science and artificial intelligence under supervision and evaluate its merits;
- Create programming code either for the purposes of new software or for data analysis and/or representation, in line with best practices and coding standards;
- Report orally on the scientific and social-cultural merit of their project;
- Write an academic report on the research;
- Create a short video demonstration of the outcome of the project.

Procedure

Prior to registering with the thesis coordinator, students must have obtained at least 120 EC in the CSAI program (150 ECTS for fall semesters).

In the previous semester, the thesis coordinator will provide the information about the matching process in the general information page on canvas. That is, when the student filled in the matching survey and is known to be eligible for the thesis, they are matched to a supervisor at the beginning of the semester. The matching will be done by the thesis coordinator, The exact topics and the participating faculty members can vary from year to year.

The students carry out their own study, as part of the ongoing research in the program. In the first phase of the project, students work together in a classroom setting on their project proposal and poster presentation.They are guided by a member of the faculty to formulate a research question or goal pertaining to their topic. The member of the faculty will monitor the writing process and advise students on the standards of academic writing. The first phase is completed by a written project proposal, a poster and a short oral presentation of the poster. All components of the first phase are evaluated with pass/fail. For students to proceed to the second phase, they need to pass all components of the first phase. In the second phase, under supervision by the faculty member who proposed the research topic, they focus on software development (if applicable), data collection and data analysis. They report their findings in a written research report (bachelor thesis). For the final evaluation of the bachelor thesis projects, students submit their written report, the programming code they created in the context of the project and a short video demonstrating the outcomes of their project.

Deliverables and steps in the assessment

Project Proposal

The project proposal is the first opportunity for students to present their project and deliverables, including a literature review of scientific articles relevant to the content of the project. The project proposal is evaluated with a pass/fail and constitutes an instance of a summative assessment.

Please see the proposal guidelines as well for more details.

Poster Presentation

The poster presentation is the second opportunity for students to present their project. The poster presentation consists of a short oral presentation (maximum 5 minutes), a demo (where applicable) and/or a video and a poster. All students present their projects to scientific staff members and other students in an exhibition-like setting. If applicable, students should process the feedback given by the examiner (the supervisor of the thesis cluster in which the student is conducting the project), other lecturers and peers in the final deliverables handed at the end of the project. The poster presentation constitutes an instance of summative assessment and is evaluated by a pass/fail by the examiner.

Final Deliverables

For the thesis project to be evaluated, the following deliverables are required:

- A written report including a reflection on the student's development (further information can be found in the Bachelor Thesis Guidelines);
- The programming code created in the context of the project (e.g., R code for conducting statistical analyses and visualizations, Python code for machine learning or Unity code for VR applications);
- A demonstrator (short 2-minute video describing the content and outcomes of the project).
- A self reflection essay

The final deliverables are assessed by the first and the second examiner independently and in line with the Exam Rules and Regulations. This evaluation constitutes a summative assessment and results in a final verdict which is communicated to the student within 15 days after handing in the final deliverables. The first examiner carries the main responsibility for the judgment and the quality of the assessment. The second examiner is there to assure that a fair and sound verdict is reached.

The first examiner delivers the result and feedback to Canvas and the thesis coordinator shares the grades with to administration. Students have the right of inspection and should be notified of this right by their examiner. Consequently, students can request a meeting with the examiner to clarify the arguments for their grade.

Assessment

See separate document, 'Rubric Bachelor Thesis'. Please be aware, the guidelines have an advisory function and the rubric captures the criteria the grade is based on.

Written Report Content Requirements

Length

The length of the manuscript should be between 6,000 and 8,000 words, excluding references and appendices. Make sure you do not exceed this limit.

Elements of your report

The thesis consists of the following sections:

o Title page

o Abstract

o Introduction

o Related Work

o Methods/ Experimental Setup

o Results

o Discussion

o Conclusion (discussion and conclusion can be combined to a single section)

o References

o Appendices and Supplementary Materials

Title page

Contains the title, author and other standard information. Please see the template. The title summarizes the substance of your thesis. Typically, it informs readers about what the research topic is and how it is being investigated; findings and other details are usually left out. Ideally, it should be less than 12-15 words. Here are some rules of thumb for formulating the title:

o Be clear and avoid ambiguity;

o Avoid being overly general or vague;

o Be succinct; the finer details should be included in the Abstract (see section below).

Abstract

The summary is a very brief but self-contained account of your thesis. It should be around 150-250 words. The following points should be addressed:

o What problem is being investigated?

o What is your research goal? It should follow from how other researchers addressed the problem (i.e., in terms of approach, focus, etc.) in the past.

o What distinguishes your approach from theirs? What are the essential features of your method?

o What dataset are you using?

o What are the main findings?

Introduction:

Explain briefly what your research goals are, why they are important, how you approached them, and what your findings were.

Once the introduction is read the goals of the project or research questions and the framework of the project (the research strategy, (what the proposed approach is) must be clear to the reader and this approached should be motivated such that the reader understands it fits the objective of the research. This section mainly relates to the "Formulation goals, framework project" criterion of the rubric. The research strategy and outline must be clear. the abstract must include the summary of the findings and the research goal.

o **Context**

o Start with the goal of your research

o Describe the context of your thesis in a very concise manner. Explain briefly the research domain, what the state-of-the-art is, and why the subject matter is interesting. Your readers should be left feeling that your thesis deals with an issue that is both important and interesting.

o Explain the scientific and social relevance of your work

o You do not need to go into great lengths to describe every relevant prior study yet; that should be reserved for the section on related work. For now, it is fine to state something along the lines of: This issue has been addressed extensively (see Section 6)

o Devote one paragraph of the introduction explicitly to the scientific relevance of your project. Note that scientific relevance could be derived from the domain specific research goal addressed in your research, or in the proposal of a new algorithm or approach.

o **Research questions/goals**

o Once the context is established, specify you research questions/goals.

o **Findings**

o Give a brief (one paragraph) overview of your main findings.

Related work:

This section should include references to relevant theories and models, and they should be related to the description to the project at hand. Student should avoid redundant references here. This section mainly relates to the "Theoretical underpinnings, use of literature" criterion of the rubric. The discussion of the literature should allow the reader to put the work in perspective. There should be comparison in terms of this work versus the papers cited, for similarities and differences. The student should include existing recent literature to provide a good state of the art overview.

Explain the larger scientific context of the problem: what is the theory behind it if any, what previous research has been done related to it, and how your work builds on this related research. Below are some step-by-step guidelines for writing this section:

o Specify the area of research in which your work belongs and provide a context for the research focus. What research issue is your work focused on? Why is it an issue of importance?

Aim to cite five sources from the last five years. If this domain is not active in the recent years, and there are no recent papers, note that in the thesis.

o Describe relevant work conducted in the same research area (with proper references). Has this issue been addressed in the literature? By whom? What have they done and found? What are the relevant theories? Are there any contradicting findings or competing models/theories? What is the state of the art?

o Identify research gaps and/or shortcomings of existing method; define research problems:

- What is missing from prior research? What are the limitations of existing models? Could there be alternative approaches to solving the same problems?
- Specifically, what research problems are left unanswered? What insights or implications will you tackling these research problems bring about?

o Specify the research questions and goals of current work; announce the methodology you are going to adopt. What are the research goals? What are you trying to achieve with the current work? How are you going to fill the research gaps? What sets your work apart from prior research? What dataset are you going to use?

Common problems and remedies:

✗ Failure to maintain focus on the research goal, by including references to studies that are only remotely related to yours.

✓ Make sure you are not trying to impress the readers by the broad scope of your knowledge, thereby forgetting that they are interested in your current research only.

✗ Failure to support statements with adequate references.

✓ Always give credit where credit is due. If you are making a statement along the lines of: It has been established in prior research that…, make sure you follow the statement with references.

✗ Failure to express arguments or ideas in your own words.

✓ It is not acceptable to simply paraphrase the work of someone else by changing a few words here and there, without acknowledging the source. If you must include a direct quote, enclose it with quotation marks and specify the page number in your

reference. Failure to do so is a case of plagiarism and can lead to severe consequences!

✗ Failure to include references to recent work.

✓ Whilst certain dated works remain important and are still widely cited (e.g., Gold, 1967, if the research concerns grammatical inference), try to stay on top of developments in the field and refer to the more recent literature, for example include references from the last five years in the field.

✗ Failure to critically reflect on the literature.

✓ Demonstrate awareness of relations among existing models or studies by specifying any relevant commonality, contradiction, or inconsistency among them. ✗ Failure to give a convincing rationale for conducting the current study.

✓ Explain how the current work continues and improves upon previous lines of enquiry. Be explicit about the contribution of the current work

Methods:

This section relates to the "Use of methods and processing data" criterion of the rubric. Description of methods and analysis of information/data should be complete. Used methods and analysis of data/information should be appropriate for the goals of the project. The chosen methods should be compatible with the research goal and this should be explained clearly. Notation should be clear and consistent. It's not necessary to elaborate in details on standard or common methods/techniques.

In this section you describe your general approach, for example which experimental methods, mathematical models or computational algorithms you used. This section should describe in detail exactly what you did. This section often contains a combination of mathematical formulas, diagrams, and verbal descriptions. The following information should be covered:

o Description of the experimental procedure:

- Was it research done on humans or simulations?
- How was the population recruited and the test administered?
- What was the task participants completed?
- In the case of simulations, which algorithm was used, which parameters were chosen and how.

o Description of your dataset (if relevant): the organization offering the dataset, sample size, how and when the data was collected, which features could be found in the data, and any other relevant information

- Where appropriate, report descriptive statistics to offer a better impression of the dataset.

-Cleaning / pre-processing of data: was there any oddity (e.g., error) in the dataset and what was done about it, which parts of the data were discarded and why, whether or not certain features were transformed and why, what was done about the missing values and why, and any other preprocessing done

- Always justify your decisions with theoretical and/or statistical arguments

o Description of the actual implementation, i.e., programming languages and versions, packages used, proprietary applications supporting the coding, cross-validation methods, etc.

o Description of evaluation criteria

Common problems and remedies:

✗ Symbols in formulas are not defined or explained.

✓ Make sure that it's clear what the notation stands for.

✗ Failure to list all important details.

✓ Always write with other researchers in mind and include all relevant details. When in doubt, ask yourself: If I were to leave this piece of information out, would other researchers be able to reproduce my work?

✗ Failure to justify choices made.

✓ Always be explicit about the rationale for making certain choices; they should be made on theoretical (e.g., prior research), methodological (e.g., algorithmic bias) or empirical grounds (i.e. tuning on validation data). For example, it is better to use only one or two algorithms properly than trying out every algorithm under the sun without proper justification and in a superficial way.

Results:

This section is related to the "results and reflection on results" criterion of the rubric. You should indicate all weaknesses in the results and weigh them relative to each other. Better alternatives for the methods used should also be discussed here ideally.

In this section, you report your results, often with the help of statistics, tables, and figures. Below are some guidelines:

o Present your results in a structured manner, often with the help of tables or figures.

- In your text, do not simply restate the information listed in the tables or figures. Try to make sense of the results, highlighting important or interesting findings that you might revisit in the discussion section. The figures are not the presentation of your results but their illustration.

- Do not leave information presented in tables or figures unexplained. You have included information there for a reason, so take the time to go through it (e.g., explain what each column is about).
- Provide high quality clear figures with well-sized legends and informative captions.
- Do not cluster tables and figures – there should always be some text in between.
- Larger tables (with more than ca. 10-15 rows) should be placed in the appendix.

o Where appropriate, explore the results further by means of statistical analysis, confusion matrices, or visualizations

- The goal is to obtain a more fine-grained understanding of your results, uncovering patterns that might not be obvious from the overall results (for example, does the overall pattern of results hold across ages and genders? Or, in the case of a AI model, does the predictive performance of the model differ greatly between classes).

Common problems and remedies:

✗ Failure to report the baseline performance for a machine learning problem.

✓ Always report the baseline performance, as it is difficult to interpret the results without knowing the basis for comparison (e.g., previous research, chance-level performance, etc.)

✗ Failure to interpret information listed in tables and figures.

✓ Eloborate on the take away of (your findings in) the tables such that your readers know what they should focus on .

✗ Failure to use the correct type of figure.

✓ Consult scholarly articles and books to see which type of figure is appropriate for which visualisation purpose.

✗ Failure to format numbers according to English-language conventions.

✓ Make sure you use decimal points, and commas as thousand separators (i.e. 1.2 and 10,000)

o First, describe in one or two sentence(s) what results will be reported in this section. For example: In this section, classification performance for the feature types described in section 3 on X dataset will be presented.

o Describe the model performance or statistical results, which can be listed in a table. Be clear about which tables or figures you are referring to. Do not simply repeat the information found in the table. Summarize and explain the analyses.

Discussion and conclusions:

The research goals should be listed in these sections, and elaborated on in relation to results. These two sections may be combined. These sections are related to the "Conclusion and discussion" criterion of the rubric.

Discussion

In Discussion you should evaluate your results with regard to the research goals presented in the introduction. The following are some recommended elements:

o Remind you readers what the goal of your study was.

o Discuss the findings, preferably in the same order in which they were presented in the results section.

o If a finding was surprising, you should offer reasonable speculations as to why this particular result was observed.

o It could be the case that your results only partially answered your research goals due to limitations of the model or the data. Acknowledge these limitations, offer possible solutions, and defend the validity of your results.

o Put your results in perspective by making links to the literature.

o Make very clear what the contribution of your study is within the existing framework.

Common problems and remedies:

✗ Failure to provide context for the results

✓ The discussion section should be understandable when standing alone. It is important that you spell out your research questions or goals again, so that researchers who only read this section can still have a good idea of what your findings are.

Conclusions

Conclusion is a short section where you restate the research questions/goals and provide the answers to them by combining the results you obtained with a **very brief** summary of how they can be placed in the context of existing research. Here you also explain the implications of your work for the field, and identify which directions future research could take, on the basis of the contribution of your study.

Acknowledgements (optional)

In this brief section you can acknowledge sources of funding, data, or anyone who helped you with your research.

References

It is recommended to use an author-year citation style such as APA.

Appendices and Supplementary Materials

Appendices are appropriate for extra, non-essential visualizations, examples and analyses. It is strongly encouraged, whenever possible, to store data and source code in an online repository and refer to it in the manuscript. Github.com is a common choice. It is not ideal to include code in the thesis report.

Copyright and collaboration

Make sure your thesis does not contain unacknowledged quotes or paraphrases as these could be detected as cases of plagiarism. For the same reason, do not reuse any figures or other images without a proper license or a permission of the author; if you have the permission, the author still needs to be credited. If you collaborated with someone else on some part of the project, indicate clearly which part of the work you are building upon was done by something else.

Checklist for Fluency of language and writing

The below list mostly concerns the "Fluency of language and writing skills" criterion of the thesis

- Is the length within the specified limits?
- Are there any redundancies (irrelevant content must be removed).
- Is the content presented in a logically sound way?
- Did you run a spell checker?
- Did you proofread for grammar and clarity?
- Did you use English-language conventions for number formatting (decimal point, comma thousand separator)?
- Did you round excessively precise numbers?
- Are all quotes and paraphrases from other texts properly referenced?
- Are all figures either your own or used by permission?
- Are the symbols used in formulas defined or otherwise explained?
- Does the thesis conform to the necessary formatting of a Tilburg University TSHD bachelor thesis document, including approved citation styles and the title page?
- Is there a Data,/ethics/code statement?

Thesis template can be found in the corresponding module. The provided LaTex template is consistent with the Tilburg University Bachelor Thesis style requirements

If you opt to write your thesis using another program (Microsoft Word, for example) you must be sure your thesis is consistent with these style requirements.

The template uses APA6- or IEEE-style citations (using APA6 or later is versions are accepted), bibliography and some formatting elements (e.g. 2-column for IEEE)

Thesis title page Download pagein Microsoft word.