



A Compendium of dates, tips, guidelines and procedures

This guide informs members of the ORFE class of 2025 of what they might expect throughout their Senior Thesis process. These guidelines apply to all students who are choosing to satisfy the graduation requirement of writing a Senior Thesis -- based on two semesters of independent research.

Class of 2025

PRINCETON
School of Engineering and Applied Science

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WHAT IS A THESIS?

The most frequently asked questions concern what is actually in a Thesis (how much detail, how long should it be, etc.). This section of the guide is a strictly informal set of guidelines that a student may use to orient him/herself as to the basic components of a thesis. Since projects differ widely, it is impossible to develop a general outline that applies equally to all students. Regardless of how well you think your own research fits the following guidelines, you should talk to your advisor to determine the most appropriate style of presentation for your own work.

The essence of any scholarly work, which a thesis is supposed to be, is to establish the following:

- Definition of the problem and review of the literature
- Presentation of your particular contribution to this area
- Identification of fruitful areas of further research that others in the field may use to guide their own work

Toward these three goals, the following list of questions may prove useful for organizing both your research effort and the final writing of the thesis.

What are you looking at?

You must begin by defining your problem. In the introduction of the thesis, however, you want to do this in a general way that gives the reader a sense of the scope of the project and a basic understanding of your problem area. For example, you may be solving a problem of interest to a particular company, or developing a new approach to a problem that may be of interest to the research community as well.

Why are you looking at it?

Motivate your work – both within the research community, and more broadly. Explain

to the reader why you will not simply waste his/her time on an uninteresting problem if he/she reads your thesis. Establish who will benefit from your work and why.

Who else looked at it?

With a rough idea of what your problem is, you must firmly now establish the state of the art in the area. This is particularly critical if you wish to claim that you have a better way of solving/approaching a problem than has appeared previously in the literature. If you are duplicating the approach of others, but using a different data set that is of particular interest to you, it is important say so and describe why you have chosen this particular approach / data.

How are you looking at it?

At this point, you may need to review your problem again but at a much higher level of detail, introducing any mathematical notation required and describing any subtle aspects of your problem. Empirical research, which involves gathering data to prove some relationship, can often be introduced by citing one or more hypotheses which you feel your research will prove (or disprove).

After stating the relevant hypotheses, your work should describe the process of collecting and analyzing data to confirm or deny your hypotheses. The most interesting hypotheses are ones that run counter to prevailing public opinion, although these can be very difficult to prove.

Not all work is conducive to initial statements of hypotheses, particularly methodological theses which are aimed at better solutions to existing problems (the implicit hypothesis is that your method is better than others, but this need not be stated as such). In any event, unless your work is purely theoretical, you should describe in detail your experimental design: how you structured your data collection, problems you encountered, and how you conducted your experiments.

In any case, the description of your work should be sufficiently detailed to allow another

researcher to duplicate your efforts. A key part of your description should be a clear list of major assumptions you are making and why you are making them. It is useful at the same time to indicate which assumptions are perfectly reasonable (e.g. other researchers have used the same assumption and have obtained good results) and which are likely to affect your results but are required for time/budget reasons.

What are the limitations of your work?

One of the most difficult aspects of research is understanding exactly what you did and what you did not do. If you were limited by your data, explain how you think this might affect the generality of your conclusions. Discuss openly any shortcuts required due to time/budget/data availability constraints. Be humble!! Do not try to claim credit by stating that you feel that your method/model will work in more general situations if you have done only limited testing. At the same time, do not feel you are getting off the hook by over-qualifying your work. Clearly drawing the line between what you did and did not do is a central step in the scientific method since it helps define the state of the art.

What are your conclusions?

In view of the limitations above, what conclusions can you draw from your research? Because your conclusions are often inextricably intertwined with the limitations of your research, both questions are often answered simultaneously. It may be useful to discuss limitations of specific aspects of your work while you are describing the results, but generally you should defer a discussion of how such limitations until later. Your section on conclusions should specifically and clearly describe your contributions to the field and the relevant limitations. Again, do not underrate your work, but do not claim to have solved problems that are not firmly substantiated in the body of the thesis.

What next?

Finally, you should identify areas for future research. Now that you are an expert in your particular area, you should have both a narrow understanding of a well-defined problem as well as a broader understanding of the field as a whole. As such an authority, you can guide others in directions that you feel will provide the greatest good. Such recommendations are

usually based on an evaluation of the major weaknesses in your own work, in which case you might recommend how others (preferably with more time and funding than you enjoyed) could overcome these weaknesses. Be sure, however, to specify those weaknesses that you feel would have the greatest impact on your conclusions. Some assumptions that you may have made may be perfectly reasonable!

LOGISTICS AND ADMINISTRATIVE REQUIREMENTS

The Senior Thesis process is a full year, 12-month effort, which really begins during the end of students' junior spring semester. In both the Fall and the Spring semester, you should be prepared to devote about the same amount of time that would be needed to attend and satisfy all of the requirements of a normal advanced course. Administratively you are required to register for ORF 498 in the Fall, and ORF 499 in the Spring of your senior year. Keep in mind that in order to be a full-time B.S.E student, you need to enroll in at least four courses each term.

The Senior Thesis Classes (ORF 498/499) are intended to help structure your research time and gauge your progress so as to avoid the dreaded Thesis rush at the end of the year. We also aim to provide you with greater and more continual feedback on your work, while introducing you to different tools you might need during your Thesis. Key dates and deadlines and certain rules and procedures governing the preparation of the final document are also contained herein.

Students who don't wish to continue with their Thesis can switch to ORF 497 (One Semester Project) by September 13, 2024 (the end of the Add/Drop period), and will be required to take eleven departmental electives instead of the ten required when doing a Senior Thesis.

IMPORTANT DATES

The following dates represent the key milestones over the year. Further details on each milestone are given in later sections of this guide.

Friday, September 20, 2024	SENIOR THESIS PROSPECTUS
Friday, October 25, 2024	ORF 498 MIDTERM REPORT
Friday, December 13, 2024	ORF 498 FINAL FALL REPORT
Friday, February 28, 2025	ORF 499 PROGRESS REPORT
Thursday, April 10, 2025	DEADLINE FOR SENIOR THESIS
Tuesday, April 29, 2025	SENIOR THESIS SYMPOSIUM (oral presentations)

SENIOR THESIS FUNDS

Limited funding is provided by the School of Engineering and Applied Science for theses which require financial support for special travel needs, acquisition of data, or other special requirements. Awards are typically around \$250-500, but not all proposals can be funded. Talk with your advisor if you feel you may qualify for this support. Thesis funding is announced in both the fall and spring semesters, and students should plan on creating a detailed proposal if interested.

MUDD LIBRARY THESIS ARCHIVE

Mudd Library's Senior Thesis Archive enables Princeton students to access submitted copies of senior theses online. When using the database, students may select the department to view theses from previous ORFE classes.

Link: <https://library.princeton.edu/special-collections/databases/catalog-princeton-university-senior-theses>

ORGANIZING YOUR TIME

Every thesis looks very different, and as a result it is difficult to provide a single, universal timeline for students' progress. However, time management and organization are extremely important skills to develop during your work.

It may be helpful to divide the effort into some primary tasks:

- Defining the problem and reviewing the literature
- Dividing the problem into smaller tasks (e.g. data collection, data cleaning, etc.)
- Doing the work (including experimental work, if applicable)
- Writing the thesis

Both ORF 498 and ORF 499 will aim to support your organization and time management through precept-like 'Research Groups', where you and your peers will share progress, ideas, and challenges.

Please do not underestimate how long it takes to *write* the thesis. Be sure to plan ahead!

ORF 498: SENIOR THESIS PROSPECTUS

In preparation for doing two semesters of focused research during your senior year you are required to prepare an initial report that serves as a prospectus or guide for your Senior Thesis research. This Senior Thesis Prospectus is due on **Friday, September 20, 2024**. It serves the purpose of ensuring that you have a clear vision of the work that lies ahead for you and your faculty advisor. You have had the summer to start thinking about your Senior Thesis research, and you should aim to return to campus organized and prepared to begin conducting your research. The Senior Thesis Prospectus should be a short document consisting of two paragraphs: i) the primary context / motivation for your work, and ii) the set of research questions you aim to focus on.

Later in the semester you will be defining the preliminary scope of your proposed thesis project by working out an outline. What major chapters or sections do you envision your thesis having? When might you expect completion of these parts? This is an opportunity for you to organize your time around smaller and more manageable 'parts'.

ORF 498: MIDTERM REPORT

The Fall Progress Report is due the week after Fall Recess (**Friday, October 25, 2024**). It is designed to serve as an initial checkpoint on your progress and provides an early opportunity for feedback. It should be a substantial update and expansion of the Senior Thesis Prospectus with expanded references, detailed description of data sources, if appropriate, and include an initial draft of at least some sections. You can think of this as being a “1st draft” of your thesis – albeit very much a work in progress.

It will be graded by your advisor and hence you should discuss with them what is expected. In general, however, the Fall report is expected to be 5 to 10 substantive pages in length and neatly presented. The basic outline of the report might be as follows:

- **Introduction:** What is the motivation for your research question? Why is this worth studying? What approach do you (plan to) take? Do you show that the topic is novel? Are the implications of your work clearly stated?
- **Literature Review:** What existing academic works are most relevant to your work? What are the major take- aways from these papers? How will your project differ? How will your project be similar? What tools or methodologies are most common (or important) in this area?
- **Data Sources:** If your Thesis uses data (>90% of them do), what data do you use? Where was it acquired? What kind of cleaning or pre-processing has been done? What kind of validation (if any) have you performed to ensure its quality? If you use several different datasets, how have you merged them? Is sufficient detail provided to replicate your work?
- **Analysis & Results:** If you have been able to make some progress on these areas, you should aim to fill them out. What did you do? Why? What assumptions did you make in doing so? Are your procedures logically presented and organized? What did you learn from your analysis? How do we interpret these results? What other questions come up through what you obtained? Are all figures or tables mentioned and discussed in the text?
- **Future Plan:** This Section will not appear in your final Thesis, but it is worth thinking about as you progress. What parts of your research will you be focusing on next? What do you hope to accomplish in a few weeks? A few months?

After submitting your reports, you will give a short presentation to your classmates on your progress. You are encouraged to think about this as being the first part of what you will present at the Symposium in the spring. Presentations should aim to be 3-5 minutes long, and cover all main parts of the midterm report.

ORF 498: FINAL FALL REPORT

The ORF 498 Final Fall Report is due on Dean's Date (**Friday, December 13, 2024**). It is a summary of your progress to date. In general, 30-40 typed pages are expected for this report.

The progress report will be graded by your advisor, and hence you should talk to them regarding the stage of your project and content of your report. You should aim for this to constitute about one third of your final Thesis – although students' projects will vary. Your outline for this report will likely be extremely similar to the ORF 498 Midterm Report, although more detail is expected on every front.

By the end of the fall, you should aim to have some results to present, discuss, and interpret in light of your original research question. In this report (and those that follow), we will be looking at the *product* of your research process – not just the process itself.

ORF 499: SPRING REPORT

In the spring course ORF 499 (Senior Thesis), students will be asked to submit another substantial progress report, which will be due on **Friday, February 28, 2025**. You should aim to show additional progress from the ORF 498 Final Fall Report, and this document should aim to constitute two thirds of your Thesis.

ORF 499: SUBMITTING THE FINAL THESIS

Final theses are due by 4:00 p.m. on **Thursday, April 10, 2025**, in the following two formats.

- One electronic copy submitted through the ORFE Independent Work Progress System
- One electronic copy submitted through Mudd Library.

All students are invited to come to the **Sherrerd Hall Atrium** on **April 10, 2025**, at **4:00 p.m.** for ORFE's Thesis turn-in celebration.

THE THESIS SYMPOSIUM

Capping the thesis effort is a day of oral presentations during which seniors share their work with faculty and peers. This symposium will be held during Reading Period, on Tuesday, April 29, 2025, from 9:00am to 12:00 p.m., and will be followed by a lunch.

You will have 12 minutes to describe your work, and then 3 minutes for Q&A by the audience. As it is very easy to run over this time limit, it is a good idea to practice your presentation beforehand. You are also encouraged to focus on high-level context and results of your work, since there isn't enough time to get into all the details.

GRADING

Both ORF 498 and 499 are graded A-F courses. However, the work you do during your Thesis is fundamentally different from your usual classwork. Instead of evaluating only the outcome of your work (i.e., your final Thesis), we are also aiming to evaluate the *process* behind your work. Did you demonstrate the ability to think and learn independently? To apply knowledge from other classes to solve a practical problem? Were you consistently engaged with your project? All assignments / reports / presentations in ORF 498 / 499 are intended to measure these aspects of your research process – along with the results of your investigation.

In ORF 498, your grade is broken down into the following categories:

- Participation: 20%
- Homework (including Prospectus): 10%
- Midterm Report & Presentation: 20% (= 15% + 5%)
- Final Fall Report: 50%

Note that your grade for the Midterm and Final Reports will be determined by your advisor.

ORF 499 will have similar guidelines, but more heavily weighted towards the final Thesis:

- Participation: 10%
- Writing Assignments (including Spring Report): 10%
- Final Thesis: 70%
- Final Presentation: 10%

Similar to ORF 498, the final Thesis will be graded by your advisor.

The participation component of the grade in both courses is primarily based on your attendance and engagement with your 'Research Groups' – precept-like sessions led by a graduate AI.

GRADING GUIDELINES FOR REPORTS

You will most frequently be submitting (for grade) written reports that constitute a piece of your thesis. In an effort to make the evaluation of these reports as uniform as possible, we have decided to grade them along several different categories – 6 are expected of all theses, and 4 depend on the specifics of each students’ project.

Your reports will be evaluated in each of these categories (excluding those not relevant to your specific project) on a scale of 0-3.

We expect that every thesis contains the following:

Category	Description
Writing Quality	Writing is clear, concise, and well-polished. The material is organized and tells a coherent story. All concepts and notation used are defined when needed.
Creativity	The thesis demonstrates the student’s ability to work independently on novel topics. It shows originality and creativity in the problem formulation, methodology, and/or other parts of the work.
Broader Context	The thesis is related to global, economic, social, or environmental issues. Any relevant contemporary issues are identified and tied to the thesis’ motivation and results.
Literature Review	The student has demonstrated the ability to find, read, consolidate, and interpret scientific literature. Any gaps or unresolved questions are identified and used to motivate the project. The information in the thesis is scholarly, accurate, from relevant sources, and appropriately cited
Results	The results and their implications are clearly and objectively stated. Any takeaways are interpreted through the lens of relevant prior literature, or broader societal context.
Depth	The student has demonstrated a collective, thoughtful, and exhaustive thought process in their approach to the problem. Several extensions to the students’ original problem have been

presented and studied. Overall, the thesis left “no major stone unturned”.

Almost all theses will touch on *at least* one of the following:

Category	Description
Modeling	All modeling choices or assumptions are discussed and justified. The student demonstrates critical thinking in assessing the limitations of their approach.
Mathematical Depth	Mathematical results are relevant, correct, and discussed in the main text. Mathematical reasoning is used to frame and advance the problem formulation.
Computational Component	Any computational routines used are clearly communicated, and elegantly contribute to the results of the thesis. Any assumptions or limitations of these routines are critically examined and discussed.
Data Analysis	The data collection and/or analysis performed is thoughtful, accurate, and appropriate for answering the student’s research question. Any inferences drawn from this analysis are sound and well-justified by the empirical evidence.

FORMATTING GUIDELINES

There are certain guidelines that must be followed when preparing your theses. These guidelines have been developed as a response to certain legal requirements regarding copyrights as well as administrative needs for processing the thesis.

The requirements for preparing the thesis are as follows:

1) The front page of the thesis should include title, author, advisor(s), date (April 2024), advisor(s), and the statement:

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
BACHELOR OF SCIENCE IN ENGINEERING
DEPARTMENT OF OPERATIONS RESEARCH AND FINANCIAL ENGINEERING
PRINCETON UNIVERSITY

APRIL 2025

2) The second page should contain the following statements:

I hereby declare that I am the sole author of this thesis.

I authorize Princeton University to lend this thesis to other institutions or individuals for the purpose of scholarly research.

(your signature) (your name)

I further authorize Princeton University to reproduce this thesis, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

(your signature) (your name)

Students are not required to have the thesis printed and hard bound. In the event that advisors request to receive copies of their students' bound theses, students should adhere to the following formatting guidelines:

- Must include title page.
- The thesis may be typed one and one half spaced or double spaced, with the exception of footnotes and bibliography.
- The font size should be between 10 and 12 point (10 point recommended).
- The left-hand margin should be 1½ inches to allow for binding; all other margins should be approximately 1 inch.
- All material in the thesis (tables, figures and exhibits) must be photo reproducible. Photographs may be included, but should be clear, glossy, and high contrast.
- *If students bind theses for their own personal use:* each thesis contains the title and author on the front cover, gold-stamped or engraved by the binder.