

Fulbright University Vietnam

Applied Mathematics

Capstone Handbook

As of January 2025

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# 1. General Information

## Description

A capstone project represents the culmination of a student's learning journey, showcasing their mastery of the core outcomes and competencies of the Applied Mathematics curriculum in a cohesive and meaningful manner. This individual project is conducted as a written thesis, providing students with the opportunity to synthesize and apply their knowledge in a comprehensive, scholarly work.

## Learning Outcomes

Students who complete the Capstone will be able to:

1. Demonstrate a strong mastery of foundational mathematical concepts and the capability to apply these concepts effectively in analyzing and interpreting relevant research literature.
2. Demonstrate ability to communicate mathematical ideas with precision, clarity, and coherence, both orally and in writing, using correct terminology, notation, and structured reasoning to articulate complex ideas.
3. Demonstrate advanced skills in applying theory to develop solutions for complex problems.

## Mapping to Major Learning Outcomes

	MLO1	MLO2	MLO3	MLO4	MLO5
CLO1	x	x	x		
CLO2			x		x
CLO3	x	x	x	x	

## Remember:

- Original work is **not** required. In fact, it is rare for an undergraduate thesis in Mathematics to be original and significant.
- You should think very carefully about an appropriate scope of research and production for your proposed capstone. It is important for you to consult early on with your prospective advisor about this.
- Applications which do not demonstrate awareness of the scope and the practicalities needed to realize the capstone may not be approved.

### **Projects for which there is no current faculty expertise may not be approved.**

The current full-time faculty in Applied Mathematics hold expertise in the following fields:

- Probabilistic combinatorics,
- Numerical analysis,
- Optimization,
- Financial mathematics,
- Statistics,
- Partial differential equations.

### 1.1. Eligibility Criteria

To be eligible to apply for the capstone in Applied Mathematics, you must meet the following criteria:

- Major GPA: 3.5

Capstone applicants will be assessed by the major faculty based on the eligibility criteria and the quality of the proposal.

- *NOTE: Successful capstone applicants must maintain a 3.5 GPA throughout their senior year to be able to earn an Honors for the capstone. Failure to maintain the required GPA will result in the capstone being capped at Pass.*

## 1.2. Allocation of Advisor Process

Successful applicants will provide a first choice of primary and secondary advisor and will be accommodated when prudent. If the student's first or second preference cannot be accommodated due to the necessity of maintaining a fair distribution of faculty workload, the major capstone coordinator will consult with the student to determine an appropriate solution.

## 1.3. Advising Process

The primary advisor is your first point of contact, and should hold expertise relevant to your project, for example, in terms of being a specialist in the project's disciplinary field. The primary advisor will be the primary reviewer of your work in progress, and as such, will be the person with whom you meet most frequently. Expertise does not need to be regional or topical – an advisor may have a strong grounding in the theory or methodological approaches of the capstone rather than a specific research background in that topic.

The secondary advisor can offer you additional feedback where necessary and may represent a disciplinary field outside of Applied Mathematics (if your project is interdisciplinary). In cases when the primary advisor is unable to continue, the secondary advisor will assume their role.

You should plan to meet with your primary advisor at least once a month, if not more often. **You are expected to be proactive in organizing these meetings with your advisors and to follow up on the meetings' actionable items.** The capstone places responsibility on you to be organized and to be responsible in regular communications and submission of work-in-progression to your primary advisor. **Failure to do this might lead to a "Fail".**

REMEMBER:

- ✓ Respect your advisor's working hours
- ✓ Correspond professionally and courteously
- ✓ Use Fulbright email instead of social media platforms
- ✓ Respect your professor's time

- ✓ Be prepared at meetings (with materials, questions) and use your time efficiently
- ✓ You are responsible for setting up the meetings (and showing up!)
- ✓ Expect meetings to be about at least 30 minutes

#### OTHER EXPECTATIONS:

- You cannot change your capstone's topic and format without consulting your advisors and getting their approval
- We expect you to demonstrate and maintain clear communication, a steady work ethic, a capacity for self-organization, and balanced management of your capstone workload with your other coursework
- Try to keep up with your timeline
- Manage your expectations in terms of what you can accomplish

#### 1.4. The Applied Mathematics Capstone Meetings

Approved Capstone students are expected to meet with the advisor(s) regularly (preferably weekly). The students will present any relevant updates on their project and receive active feedback from the advisor(s).

#### 1.5. Capstone I

In Capstone I you will commence research and refine your project proposal and plan. Depending on the project, this will likely include development of a comprehensive bibliography and literature review focusing on background context.

Capstone I will be assessed by a combination of your active participation in the advising processes, and both a midterm and end-of-term submission. The midterm submission must demonstrate clear progression, and will be used to facilitate your advisors in guiding your research moving forward. The end-of-term submission will demonstrate successful progress towards the final capstone submission, and satisfactory completion of the criteria listed in the above paragraph.

#### **What you might be expected to submit for Capstone I:**

Midterm submission(s):

- Initial Literature review

- Annotated bibliography

End-of-term submission (very likely a combination of some of the following):

- Revised literature review
- Initial written background
- Preliminary findings
- Other materials to be decided on in consultation with your advisors

## 1.6. Capstone II

In Capstone II you will focus more on a particular research subject that is actively developed in the mathematics community. At the minimum, you are expected to write a document that summarizes these developments with full theoretical justification.

In order to receive honors, you need to demonstrate some originality in the work. This could be (but not limited to) proving a known theorem in a different way of your own, applying what you learn to solve some interesting problems.

You will participate in research in support of your final submission. In addition to a written submission, at the end of Capstone II, you will also be required to formally present your work.

Capstone II will be graded through an assessment of a student's final submission. In addition, students are also required to actively participate in advising activities and provide regular updates including the midterm submission.

### **What you might be expected to submit for Capstone II:**

Midterm submission(s):

- Draft of the core theory
- A rough draft or outline of a thesis

End-of-term submission:

- A revised and professionally presented written thesis
- A finished applied project plus its documentation/report

### 1.7. Academic Integrity

The capstone is subject to the regulations described in Fulbright University Vietnam's Code of Academic Integrity.

### 1.8. Grading Process

As in the Appendix, there are at least two graders for each capstone project: a primary advisor, a second reader (which will be the secondary advisor, if there is one), and possibly additional reader(s).

- The Research Process will be graded by the primary advisor only.
- The Thesis will be graded by the primary advisor and other readers.
- The Presentation will be graded by the primary advisor, other readers, and all Math faculty who participate in the defense meeting.

The final score of each component is the average of all the available scores for that respective component.

### 1.9. Appeal Process

A student who wishes to dispute the final grade of the capstone project should first discuss the matter with the primary advisor and the grading committee. If the matter remains unresolved and the student believes there has been an error in grading, bias, or failure to follow published grading policies, the student may submit the [Review of Final Grade Request](#) form to the Registrar's Office within three (03) business days from the date of the defense.



## 2. Capstone by Thesis Guidelines

### 2.1. Word Count Regulations

There is no minimum word count. However, typically, undergraduate theses are often less than 40 pages, **including** full bibliography and images with captions. Your thesis must be written in LaTeX.

### 2.2. Style and Formatting

LaTeX helps you not worry about styling. You may adopt the following template with Fulbright University Vietnam logo:

<https://github.com/fuvmath/FUV-Thesis-Template/>

#### Sequence of Thesis Materials:

Preliminary pages, in the following order:

- A. Title Page. The title page should include the title of the thesis, your name, the date of submission, and your advisor's name. Include this statement on the lower third of the page:

**A thesis submitted to partially fulfill the requirements for the  
degree of Bachelor of Science in Applied Mathematics**

- B. Table of Contents. A consecutive listing of chapters or major headings with page numbers; also include the page number for the additional sections (illustrations, the appendix (if included), and the bibliography. Double space between these elements.
- C. Abstract page. Double-spaced.
- D. Acknowledgment(s) page. Optional. Double-spaced.
- E. List of Tables (as necessary), with titles and page references.
- F. List of Illustrations, with titles and page references.

**Note:** The preliminary pages should be paginated using small Roman numerals (i, ii, iii, iv, v, and so on). These may be placed at the bottom of the page. The title page counts as page i, but do not print a page number on this page. Begin the pagination with the next page (acknowledgments page, if you have one, or the table of contents).

**Bibliography.** Follow standard practice set by LaTeX. Discuss with your advisor(s) about this if you encounter technical issues.

### 2.3. Formal Presentation Requirement

While this presentation is not assessed as part of the final submission, in order for your final submission to be evaluated at the end of Capstone II you must present your work as a formal 15-minute paper at the Capstone Symposium. You are expected to attend the entire symposium and to engage with the presentations of your classmates.

### 2.4. Evaluation Criteria: Capstone by Thesis

We will follow the grading rubric in Appendix 1.

Total score: 18

Score breakdown:

- Honors: 14 and above
- Pass: 9 and above
- Fail: Below 9

## 3. Capstone Presentation

### 3.1 Timeline of the Capstone Presentation:

At the end of Capstone II, students are highly recommended to present their findings to the larger Fulbright community. The Capstone presentation presents a chance for graduating seniors to share their work and insights into the process of conducting intensive research and researched-based projects to a wider public.

The yearly presentation is planned to take place at the end of Capstone II, during the last two weeks of the semester.

### 3.2. Format of the Capstone Presentation:

The format of the capstone presentation should be decided between the student and his/her advisors. Possible formats include, but are not limited to, a powerpoint presentations, a board presentation, combination of board presentations and other media presentations.

## APPENDIX: Capstone Grading Rubric

The following is the grading rubric for Capstone projects in the Applied Mathematics major.

### Research Process

This part is evaluated by the thesis advisor only.

#### Personal development and attitude

	<b>Insufficient 0 point</b>	<b>Satisfactory 1 point</b>	<b>Good 2 points</b>	<b>Excellent 3 points</b>
Understanding the material	Fails, despite guidance from the supervisor	studies literature with guidance from the supervisor	independently studies literature	independently finds and studies literature
Critical arguments about the results, literature or specialists	Fails to understand	Understands those of supervisor	Joins the supervisor in discussing	Comes up with their own
Taking responsibility for the project and working independently; handling data (if applicable)	Takes no responsibility, shows no independence, unreliable handling.	Takes responsibility, works semi-independently, clearly needing supervision, handles data quite reliably	Takes responsibility, works independently with some need of supervision, handles data in a reliable manner	Takes responsibility for the project and works independently, and if applicable, handles data in a reliable manner
Communication with supervisor, planning meetings, leading discussions	Communicates badly, plans inconsistently, no participation.	Communicates well, plans consistently, lets the supervisor lead the discussion	Communicates well, plans consistently and actively participates	Communicates well plans consistently and takes initiative

## Mathematical development

	<b>Insufficient 0 point</b>	<b>Satisfactory 1 point</b>	<b>Good 2 points</b>	<b>Excellent 3 points</b>
Comprehensive understanding of the subject, given its difficulty	Failed to develop this	Developed this	Developed this, in its broader context	Developed this, in its broader context
Understanding and reproduce the mathematical theories used	Failed	Did this with while closely supervised	Did this, with some guidance	Did this with relatively little guidance
Development of practical (experimental/computer) skills (if applicable)	Insufficient	Know the basics and take time to implement	Developed good skills for the project	Developed good skills for the project

## Thesis

These parts below will be filled by the thesis advisor, the second reader or any additional main readers.

### Research context

	<b>Insufficient 0 point</b>	<b>Satisfactory 1 point</b>	<b>Good 2 points</b>	<b>Excellent 3 points</b>
Formulation and motivation of main mathematical questions	Inappropriate or lacking	Appropriate and well-motivated	Appropriate and well-motivated	Clearly stated, properly motivated and importance in the field is made clear
New concepts, theorems and techniques are put in context	Poorly, without understanding of own results; no consequences, open questions or future potential mentioned	Student demonstrates understanding of the results	Student demonstrates understanding of the results	Student demonstrates understanding of the results, discussed consequences, open questions or future potential

The approach is	Unclear and illogical	Clear but minor illogical points	Clearly outlined and appropriate	Clear and innovative
Relevant literature review	Missing	Included but may not be well-chosen	Well-chosen	Well-chosen

### Mathematical content

	<b>Insufficient 0 point</b>	<b>Satisfactory 1 point</b>	<b>Good 2 points</b>	<b>Excellent 3 points</b>
Overview of background	Inadequate, missing crucial elements	Given, but some elements are missing	Given with relevant literature	Given with relevant literature and interesting insights
Proofs and discussions of the subject	Weak, missing crucial elements	Given, mostly complete but not in much depth	Given, complete but not too different from the references	Given, complete and in-depth; show a great level of mastery of the subject
Creativity	Lacking	Some	Some	Very original

### Writing style and mathematical exposition

	<b>Insufficient 0 point</b>	<b>Satisfactory 1 point</b>	<b>Good 2 points</b>	<b>Excellent 3 points</b>
Style	The thesis contains a large number of spelling or grammatical errors; focus often drifts from the subject	Suitable, but sometimes inconsistent, but creates a decent flow; contains only few spelling or grammatical errors	Suitable and has a good flow; contains only few spelling or grammatical errors	Almost perfect, engaging to read
Layout and organization	Poor	Clear to read	Clear to read	Clear to read

Proofs	Poor	Minor errors	Error-free	Error-free and pleasant to read
Theorems, propositions and lemmas	Poorly chosen and not connected	Chosen with some shortcomings	Well-chosen	Well-chosen
Examples and/or figures	Absent or irrelevant	Reasonably chosen but could be better	Well-chosen	Well-chosen, interesting, and judiciously placed to aid readers

## Presentation

The presentation will be evaluated by the thesis advisor, the main readers, and all Math faculty who participated in the defense meeting.

### Content

	<b>Insufficient 0 point</b>	<b>Satisfactory 0.5 point</b>	<b>Good 1 points</b>	<b>Excellent 1.5 points</b>
The selection of topics and examples	Weak; the presentation was missing parts or did not match the audience level	Reasonable; however, sometimes the choices did not match the audience level	Reasonable, taking into account the audience level	Good, taking into account the audience level
Organization and coherence of the presentation	Could have been better; there were many shortcomings	Well enough, have a nice flow, but there were some shortcomings	Well enough, nice flow in general	Almost perfect, giving a good flow and a sense of direction

## Presentation skills

	<b>Insufficient 0 point</b>	<b>Satisfactory 0.5 point</b>	<b>Good 1 points</b>	<b>Excellent 1.5 points</b>
Interaction with the audience	Not good	Well enough, could be better	Good	Excellent
Understandability	Poor	Reasonable	Good	Good
Time management	Not knowing time	Within 10 minutes of assigned time	Within 5 minutes of assigned time	Within 2 minutes of assigned time