Senior Assessment Graduation Requirements

In addition to completing all course and university requirements, candidates for a B.A. or B.S. in Mathematics, Applied Mathematics, and Mathematics with Teacher Licensure must successfully pass at least one of the following two assessments as part of the graduation requirement for candidacy: (1) The **Senior Portfolio** and if necessary (2) the **Exit Interview**. This document gives guidelines and policies related to both items.

As of April 2022, the senior portfolio guidelines have changed significantly. Do not refer to past portfolios when writing your portfolio.

Portfolio Due Dates: The deadline for submitting the portfolio depends on the semester in which you intend to graduate:

- The due date is **February 15** for those graduating at the end of the **Spring** semester**.**
- The due date is **October 1** for those graduating at the end of the **Fall or Winter** semesters.
- The due date is **May 1** for those graduating at the end of **either Summer** semester**.**
- If the portfolio due date falls on a weekend, the due date moves to the following Monday.

⚠️**Cover Letter or Graduate School Personal Statement and Resume Due Dates:** Every student submitting a portfolio must have their resume and a cover letter or graduate school personal statement evaluated by the SPDC. For more information see Section 4. The deadlines for making an appointment with the SPDC are listed below.

- **January 15** for those graduating at the end of the **Spring** semester**.**
- **September 15** for those graduating at the end of the **Fall or Winter** semesters.
- **April 15** for those graduating at the end of **either Summer** semester**.**

Portfolio Workshops: There will be multiple portfolio workshops throughout the year. These are the best opportunities you have to get help on this portfolio. It is highly recommended that you attend multiple workshops. Portfolio workshop dates will be announced throughout the semester.

How to Submit your Portfolio: You must submit an electronic copy.

> **Electronic copy:** An electronic copy must be one PDF file. You must submit the PDF file via a link that will be posted on the MTH*0070 Moodle site. If you have issues, please contact the Portfolio Coordinator.

Senior Portfolio Guidelines

Purpose:

The senior portfolio is a **combination of narrative and evidence**, produced by the candidate, that together **argues the candidate's mastery** of the theory and applications of mathematics. The most important components of the portfolio consist of the candidate presenting arguments to demonstrate their mastery. To support these arguments, the candidate includes and cites suitable artifacts (called **Products**). The products will either come directly from coursework or arise from an approved capstone experience.

Content:

The portfolio will include a Cover Page, a ***signed*** Honor Code Statement, a Table of Contents, and five discipline-specific sections (Introduction, Concept Reflection, Foundations, Concentration, Logic, and Capstone), with each section starting on a new page with the appropriate header.

Below is a list of sections for the portfolio. You will find detailed explanations of the Sections after the outline.

List of Sections:

Sources of Help

After you have read and absorbed the contents of this Portfolio Guidelines document, you may have further questions. In such cases, you are encouraged to consult one or more of the following resources:

- **Portfolio Workshop (BEST OPTION!!).** The Mathematics and Statistics Department will offer multiple workshops during the Fall and Winter terms to help students prepare their Senior Math Portfolio. All majors should attend at least one workshop during the academic year in which they intend to graduate.
- **The Portfolio Coordinator**. This person can answer specific questions related to portfolio policies. If a candidate asks a question that is already answered in the Portfolio Guidelines or FAQ, the Coordinator will refer the student to these documents.
- **Writing Center.** Candidates are encouraged to seek feedback from the Writing Center on the narrative portions of the portfolio.

Two Transferable Skills Gained from a Math/Applied Math Major

As a math major, you develop a keen ability to solve problems using a variety of techniques. Two of these techniques are called Problem-Solving by Transformation and Problem-Solving by Decomposition. An explanation of each is given below. **In the Foundations and Concentration Sections, you will reflect on instances in which you used these skills in your Math/Applied Math Major.**

Problem-Solving by Transformation: We use this technique when we begin with a difficult problem that we cannot approach in its current form. However, we recognize that we can transform or change the problem into a much easier problem. So, we perform this transformation and solve the easier problem instead of the more difficult one we started with.

Problem-Solving by Decomposition: We use this technique when we begin with a complex problem that involves several easier problems. So, we decompose the main problem into smaller problems, solve the smaller problems, and then combine those solutions to form a solution to the main problem. When we use this strategy, the order in which we solve the smaller problems does not matter.

In brief, we use Problem-Solving by Transformation when we convert a complex problem into a single simpler problem, while we use Problem-Solving by Decomposition when we break a complex problem into multiple simpler problems.

Section 1: Cover Page

1. The cover page must be the first page of the portfolio and must include the following information: candidate's name, major(s) and associated degrees/concentrations and minors
2. If the mathematics degree is B.S., specify the major as either Mathematics, Mathematics with Teacher Licensure, or Applied Mathematics. If the mathematics degree is B.A., specify the major as Mathematics and the concentration as either Pure, Applied, or Teacher Licensure.

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Section 2: Signed Honor Code Statement

1. The second page of the portfolio must include the following Honor Code Statement:

Portfolio Honor Code Statement

> "On my honor, I certify that this portfolio upholds the four values of Elon University -- honesty, integrity, responsibility, respect -- as cited in Elon's Honor Code
>
> https://www.elon.edu/u/student-conduct/honor-code/
>
> In assembling this portfolio, I have refrained from lying, cheating, plagiarizing, and facilitating others in these actions.
>
> I understand that any violation of the Honor Code may result in receiving a failing grade on my portfolio. Further, I understand that egregious violations of the Honor Code may result in disciplinary suspension or permanent separation from Elon University."

2. The Honor Code Statement **must be signed and dated** by the candidate.

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Section 3: Table of Contents

You must include a table of contents.

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Section 4: Introductory Section

You must have the items in parts 1 and 2 evaluated by a member of the Student Professional Development Office - See below for **Due Dates**. ***PLAN AHEAD!!!*** *A confirmation of the evaluation/meeting (see part c) MUST be included in the Portfolio.*

1. **Cover Letter or Graduate School Personal Statement.** This letter, addressed to a prospective employer or graduate school, must follow professional conventions in both form and content. **This should not be a letter written for an internship.**
2. **Resume.** The resume should be professionally composed, providing the prospective employer/program with all details necessary to be considered a competitive applicant.
3. **Proof of Meeting with SPDC**. You must include verification that you have met with a member of the SPDC. This includes, but is not limited to, an email from the person you met stating you have completed the evaluation of the Cover Letter and Resume.
4. **List of courses.** List all courses that you have taken that counts towards your math/applied math major.

Cover Letter or Graduate School Personal Statement and Resume Due Dates: Every student submitting a portfolio must have their resume and a cover letter evaluated by the SPDC. The deadlines for making an appointment with the SPDC are listed below.

- **January 15** for those graduating at the end of the **Spring** semester**.**
- **September 15** for those graduating at the end of the **Fall or Winter** semesters.
- **April 15** for those graduating at the end of **either Summer** semester**.**

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Section 5: Concept Reflections

In this section, you will write **two concept reflections**, each a **maximum of 200 words** in length. The concepts must be chosen from the following courses:

1. One from a math (MTH) course numbered below 3000 (except MTH 2080 and MTH 2090)
2. One from a math (MTH) course numbered 3000 or above (except MTH 3080 and MTH 3090)

Each concept should constitute a **significant theorem, definition, or algorithm** that is of **fundamental importance** to the corresponding course or a subsequent course. In each reflection, the candidate must give a **thorough** and **mathematically-correct** exposition of the concept.

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Section 6: Foundations

In this section, you will reflect on specific instances in which you used **Problem-Solving by Transformation** in calculus, linear algebra, and mathematical reasoning or discrete structures**.**

Note: Be sure to carefully read the above **Two Transferable Skills Gained from a Math/Applied Math Major** discussion before beginning this section.

Use the guidelines below to pick three products, one from each of the following courses:

1. MTH 1510: Calculus 1, MTH 2510: Calculus 2, MTH 2520: Calculus 3
2. MTH 2310: Linear Algebra
3. MTH 3300: Mathematical Reasoning or MTH 2410: Discrete Structures

A. Each product must be a single mathematical problem that the candidate has solved on a test, homework assignment, project, or other graded work from the appropriate course. (Each product should be an individual problem and should not be an entire homework set, entire test, etc.)
B. Each product must include a statement of the mathematical problem and a correct solution to the problem *worked out by the student.*
C. The candidate should include the original product complete with instructor grade and comments. However, if the candidate does not have the original product, then they may replicate the product. The course in which the product was created must be identified by the catalog number on the product.

Note: If you do not have a suitable product for one of these courses, contact the professor that taught you the course. Faculty are required to keep all final exams and projects, so they may be able to allow you to use a product from your final exam or project.

For each product:

1. Include the statement of the problem and your solution to the problem. (These items are separate from the explanation below.)
2. Provide a detailed explanation of your use of **Problem-Solving by Transformation** within the product.
    a. In your explanation, be sure to clearly state:
        i. where you used **Problem-Solving by Transformation** in the product you selected.
        ii. why you needed to use **Problem-Solving by Transformation**.
        iii. how you used **Problem-Solving by Transformation**.

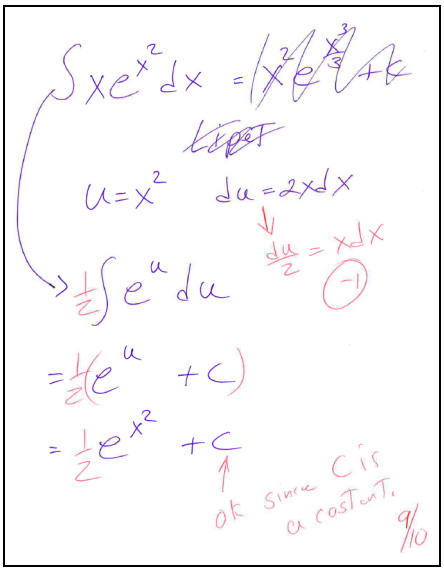
b. Do NOT explain how to redo the product. Instead, focus on the above prompts and how and where you used **Problem-Solving by Transformation** in the product.
c. The explanation for each product should be no more than 200 words long.

Note: For each of the three products you must include the following three items: (1) The statement of the problem, (2) your solution to the problem, and (3) your reflection on the use of Problem-Solving by Transformation in the product.

An Example of a complete product from the Calculus sequence:
We give an example of a passing explanation below. However, you **may NOT use any type of u-substitution problem as your product from a calculus course.** You must find another product in which you used **Problem-Solving by Transformation.**

My Chosen Product: *MTH 2510 Exam 1 Question: Evaluate* $\int x\, e^{x^2}\, dx$.

My Solution:



My Reflection:

On Exam 1 in MTH 2510: Calculus 2 I used Problem-Solving by Transformation to evaluate the above integral. I needed to transform this integral because I did not immediately know the antiderivative of $y = xe^{x^2}$. So, I used u-substitution to transform the integral into something I could antidifferentiate. I let $u = x^2$ because I recognized that the derivative of x^2 is (more or less) in the integrand. Then $du = 2x\,dx$ and so (I missed this in my solution) $x\,dx = \frac{1}{2}du$. Now we can transform the original integral into something we can integrate:

$\int x\, e^{x^2}\, dx = \int \frac{1}{2} e^u du.$

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Section 7: Concentration Section

In this section, you will reflect on specific instances in which you used **Problem-Solving by Decomposition**.

Note: Be sure to carefully read the above **Two Transferable Skills Gained from a Math/Applied Math Major** discussion before beginning this section.

Use the guidelines below to pick ONE product.

1. The product must be a mathematical proof that *the candidate has written* or a mathematical model/problem that *the candidate has generated, analyzed or investigated.*
2. The candidate should include the original product complete with instructor grade and comments. However, if the candidate does not have the original product, then they may replicate the product. The course in which the product was created must be identified by the catalog number on the product.
3. The product must **not** come from a Foundations course. (i.e., The product must **not** come from any calculus course, linear algebra, mathematical reasoning, or discrete structures.)
4. For mathematics majors, we prefer that your product be a mathematical proof.
5. For applied mathematics majors we prefer that your product be a mathematical model/problem.

Note: If you do not have a suitable product for one of these courses, contact the professor that taught you the course. Faculty are required to keep all final exams and projects, so they may be able to allow you to use a product from your final exam or project.

For your chosen product:

1. Include the statement of the problem and your solution to the problem. (These items are separate from the explanation below.)
2. Provide a detailed explanation of your use of **Problem-Solving by Decomposition** within the product.
    a. In your explanation, be sure to clearly state:
        i. where you used **Problem-Solving by Decomposition** in the product you selected.
        ii. why did you choose to use **Problem-Solving by Decomposition**.
        iii. of how you used **Problem-Solving by Decomposition**.
3. Do NOT explain how to redo each product. Instead, focus on the above prompts and how and where you used **Problem-Solving by Decomposition** in each product.
4. The explanation should be no more than 200 words long.

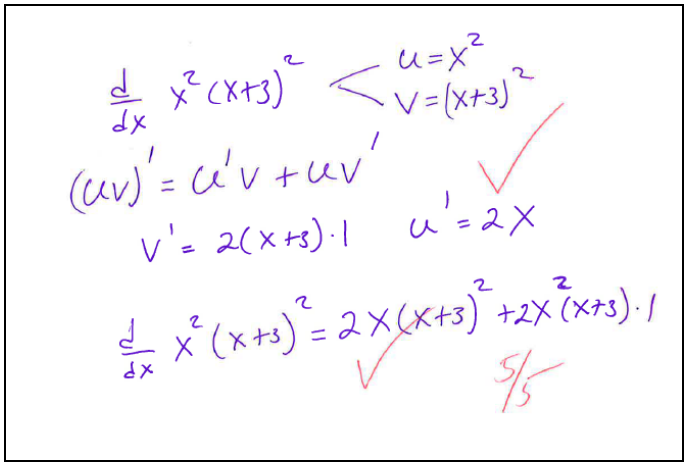
Note: You must include three separate items for this section: (1) the statement of the problem and the class it came from, (2) your solution to the problem, and (3) your reflection of the solution.

Some topics you <u>might want</u> to consider:
Proofs: Proving that something is true by proving that properties a, b, c... are true
Models/Problems: A mathematical model in which an argument is made with several different mathematical pieces of evidence or a problem where both theory (or theorems) and algorithms are applied.
Note that you do not have to use these ideas. You have had many other opportunities to use Problem-Solving by Decomposition in your classes.

An Example:
We give an example of an appropriate explanation below. However, this example is pulled from Calculus I which is **not an** acceptable source for this section; you **may NOT use any type of differentiation-by-rules problem as your product.** You must find a product from an appropriate course in which you used **Problem-Solving by Decomposition.**

My Chosen Product: MTH 1510 Exam 1 Question: Evaluate $\frac{d}{dx}(x^2(x+3)^2)$ analytically.

My Solution:



My Reflection:
On Exam 1 in MTH 1510: Calculus 1 I used Problem-Solving by Decomposition to do the differentiation problem. This was the correct approach because the problem actually involves a number of functions combined together into one complex function. By using derivative rules, I was able to decompose this differentiation problem into a number of much simpler derivatives. First, I recognized the product rule which allowed me to do the derivatives $\frac{d}{dx}x^2 = 2x$ and

$\frac{d}{dx}(x+3)^2 = 2(x+3)^1(1)$ separately. The first was a simple power rule and the second was a generalized power rule (chain rule) which allowed me to finish the problem.

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Section 8: Logic Section

In this section, you will be given a statement in the “If-Then” form along with individual questions you will have to answer. The statement will be emailed to you at least one week prior to the due date for your portfolio.

> The statement you have been given is in the form of “If *P* then *Q* ” ($P \rightarrow Q$). You may assume the statement is true without proof.

1. *What is P in the context of your statement?*
2. *What is Q in the context of your statement?*
3. *If we are given that P is true, state, in the context of your statement, what (if anything) we conclude about Q?*
4. *If we are given that Q is true, state, in the context of your statement, what (if anything) we conclude about P?*
5. *If we are given that Q is false, state, in the context of your statement, what (if anything) we conclude about P?*

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Section 9: Capstone Section

In this section, you will reflect on your capstone experience.

Product:
Include one capstone product. Acceptable capstone products include:

a. Final Research Paper
b. Final Internship Paper
c. For teaching licensure candidates, Unit Plan from Methods (focusing on math content knowledge)

The product must correspond to the capstone experience of the candidate's chosen concentration area. For example, teaching licensure students must include item (c). Other concentrations will use the item (a) if they conducted research (either through Seminar or Independent Study) or item (b) if they completed an internship.

Note: If you are currently working on your capstone, please contact the Portfolio Coordinator with a request to change the inclusion date of the Capstone Section.

Rationale:
Provide a **detailed description** of the capstone experience and a **strong argument** of how the experience has helped you achieve mastery in the following three areas: (1) **application of knowledge**, (2) **communication of knowledge**, (3) **independent thinking**. You must use your chosen capstone product to support your argument. Specifically, you must clearly identify *where* and *how* your capstone product demonstrates mastery of items (1), (2), and (3) above. The rationale must be at least **one page** in length.

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Evaluation of the Portfolio

Portfolios will be assessed independently by two faculty reviewers from Elon or another university. Each reviewer reads the candidate's portfolio very carefully and issues either a pass or fail on each section. The reviewers give their evaluations to the Portfolio Coordinator who will then notify candidates of the results of their portfolio evaluation no later than one month after the due date. The possible outcomes of the portfolio evaluation are as follows:

- **The candidate passes the portfolio**. This means both reviewers issued a pass on each portion of the candidate's portfolio. The candidate does not have to participate in the exit interview process.
- **The candidate needs to submit revisions**. This means at least one reviewer has issued a fail on at least one portion of the portfolio. If a reviewer issues a fail on a portion of the portfolio, the candidate will be required to revise and resubmit that portion of the portfolio.
    - Each fail will be accompanied by comments from the reviewer(s). The candidate **must address all comments** in their revision.
    - The Portfolio Coordinator will contact the candidate by email listing all required revisions and their corresponding reviewer comments. This communication will also contain the due date for submitting revisions.
    - To submit revisions, the candidate will send **one email** to the Portfolio Coordinator. This email should contain a separate PDF file for each item that requires revisions as well as a single PDF file of the entire revised portfolio.
    - If revisions are not received by the due date, the candidate will receive a fail on the entire portfolio and will not be able to graduate with a mathematics/applied mathematics major during the current semester.

  Once revisions are received, the reviewers will assess all revised documents one final time. The reviewers give their evaluations to the Portfolio Coordinator, who will then notify the candidate of the outcome of their revisions. The possible outcomes are:

    - **The candidate passes the revisions.** The candidate has successfully completed the portfolio requirement for graduation. The candidate does not have to participate in the exit interview process.
    - **The candidate fails the revisions**. The candidate has not successfully completed the portfolio requirement for graduation. The candidate must continue to the Exit Interview Process. (See Exit Interview Guidelines)

Exit Interview Guidelines

If the candidate has not passed the portfolio process by the end of the revision process, they will be contacted by the Portfolio Coordinator to set up their Exit Interview. The purpose of the Exit Interview is to judge the candidate's ability to discuss and interpret factual material concerning mathematics and its applications. The Interview will be administered by at least two faculty from Elon's Department of Mathematics and Statistics and will be graded on a Pass/Fail scale. Each candidate will be informed of their interviewers' names and must contact them immediately to set up their Interview. All Exit Interviews must be scheduled within two weeks of being notified of their interviewers' names.

Interview Format

- Exit interviews will be approximately 30 minutes in length.
- Candidates will be asked to discuss the mathematics reported in **any** of the products that were included in their portfolio.
- Candidates will be asked to orally explain mathematical ideas, methods, or results using mathematical language correctly.
- Candidates will NOT be informed of the product choices before the interview so should familiarize themselves with all their submitted products.
- The possible outcomes are:
    - **The candidate passes the Exit Interview.** The candidate has successfully completed the portfolio requirement for graduation. The Portfolio Coordinator will email the candidate a link to the Senior Survey, in which they rate their confidence in the skills related to the program learning objectives and offer feedback on the math major, teaching effectiveness, advising, and course offerings.
    - **The candidate does not pass the Exit Interview.** The Portfolio Coordinator will confer with the interviewers to determine where the deficiencies are located and relay this to the Candidate. The Portfolio Coordinator will set up a last-chance interview with the Candidate, a faculty member, and the Portfolio Coordinator.
        - If the candidate passes this last-chance interview then the candidate has successfully completed the portfolio requirement for graduation.
        - If the candidate does not pass the last-chance interview the candidate will not meet the portfolio requirement for graduation. Within a week, the candidate will have to meet with the Portfolio Coordinator and Department Chair to discuss a plan for additional work to be completed after the current semester ends.