

Math 3410 Course Outline

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Abstract

As you continue your study of linear algebra in this course (Math 3410), you likely have many questions, such as: “What is a vector, anyway?” and “Is this on the test?”

The uncertainty around online vs. in person teaching prompts even more questions. This outline is intended to serve as a roadmap, to guide you through the various components of the course.

1 Introduction to Math 3410

Welcome to Math 3410, Linear Algebra. Although it doesn’t take up as much space in our list of course offerings as Calculus, Linear Algebra is arguably the more useful subject, in this era of computer graphics and big data.

There are many of us in this class, coming from many different backgrounds and situations. If the “default settings” for the class don’t work for you, please don’t hesitate to ask for accommodation. Not everyone has reliable high speed internet. Not everyone is able to attend scheduled classes without work/family/life getting in the way. But everyone deserves a fulfilling, enjoyable learning experience in each class.

I am committed to making our Math 3410 classroom, whether online or in person, an inclusive and safe space. I expect all of you to make the same effort. Everyone is welcome. We are learning this material together, as a class. You should see yourselves as colleagues, not competition.

We begin with some introductions: to the university, to the staff, and to the course.

1.1 Welcome to the University of Lethbridge

Oki, and welcome to the University of Lethbridge. Our University’s Blackfoot name is Iniskim, meaning Sacred Buffalo Stone. The University of Lethbridge acknowledges and deeply appreciates the Siksikaitsitapii peoples’ connection to their traditional territory. We, as people living and benefiting from Blackfoot Confederacy traditional territory, honour the traditions of people who have cared for this land since time immemorial. We recognize the diverse population of Aboriginal peoples who attend the University of Lethbridge and the contributions these Aboriginal peoples have made in shaping and strengthening the University community in the past, present, and in the future.

As usual, everything you need to know for the course will flow through our [Moodle](#)¹ learning management system. Make sure you check in regularly to keep on top of what’s happening in the course. (Possibly the hardest part of learning online is keeping track of deadlines.)

Don’t hesitate to reach out if you have questions. I’ll do my best to answer all of your course-related questions as quickly as possible. (See [Section 3](#) for details on how to get in

¹moodle.uleth.ca

touch.) If you have questions that are not related to the course, you can ask those too, and I'll try to answer, or to direct you to someone who can. Some resources can be found on the University's [Health and Safety website](#)².

1.2 Course staff and contact information

Math 3410 is running for Spring 2022 with a single section of about 40 students. (We're online to begin with, but once we return to campus, 40 is all that will fit in the room.) My name is [Sean Fitzpatrick](#)³. I can be reached via email at sean.fitzpatrick@uleth.ca.

About me: I am originally from Selkirk, Manitoba. My background is mostly Scottish, Irish, Dutch, and Métis. I was the first person in my extended family to attend university, although my parents both attended college. I'm male (he/his), married, and have two kids who will probably appear behind me on Zoom from time to time if the elementary schools move online.

Student (office) hours: you will be able to book appointments, alone or in groups, using a Calendly provided on Moodle. I'll also usually stick around for awhile after class ends.

1.3 Course description

Math 3410 is the continuation of the study of linear algebra you began with Math 1410. Some topics will be familiar, like vectors, matrices, and systems of equations. But Math 3410 has a much greater focus on theory and proof.

At many universities, linear algebra is offered as a first course with rigorous proof. (Many places do not have an equivalent of Math 2000.) One reason for this is that most proofs in linear algebra are straightforward (relatively speaking). Many theorems in linear algebra follow the classic "if ... then" format of a conditional statement. The corresponding proofs tend to follow a familiar script:

1. Assume the hypothesis.
2. Translate the hypothesis using the definition of some term in the hypothesis.
3. Rearrange some terms (i.e. do some algebra).
4. Recognize that you've met the definition of some term in the conclusion.
5. Translate to the conclusion using that definition.

We won't focus entirely on theory and proof, however. Linear Algebra has many interesting applications, and we'll try to fit in a few. We'll also include computational content. In particular, we'll spend some time learning how to use the computer to do some of our calculations for us.

1.4 And what about the whole online thing?

Fortunately, most of my planned assessments were going to be online anyway. The only thing that really changes with the shift back to online is how we meet. Once (I hope) we return to campus, we'll meet in a classroom rather than Zoom. For those who cannot be there in person, I'll continue to maintain a Zoom link, and to record where appropriate.

In comparison to a "traditional" in person class, you should expect

- More emphasis on:
 - Conceptual understanding

²www.uleth.ca/services-for-students/health-safety

³www.cs.uleth.ca/~fitzpat

- Discussion
- Context (the whole “what is this good for?” routine)
- Being generally swell human beings
- Less emphasis on:
 - Memorization (because how am I gonna stop you from looking stuff up, anyway?)
 - Routine computational proficiency (let’s be honest: the computer can do this better than us most of the time)
 - Tests and exams (so I can spend more time teaching and less time as the Math Police)

2 Essential course information

This section covers essential course information, including the meeting times, textbook, and grading scheme.

2.1 Course website

The primary course website is [Moodle](#)¹. On Moodle, you can expect to find:

1. Links to important resources, like this syllabus, and the textbook.
2. Links to key course activities, including the online homework, and the discussion forum. (The links will log you into those services automatically.)
3. Details about your grades and assessments.
4. A weekly topics schedule.

In case there’s a day when Moodle isn’t working properly and you need access to course materials, you can find some of them (like this syllabus) on my [personal website](#)². The textbook for this course (and many others) is available on our [Open Textbook Server](#)³.

2.2 Scheduled classes

We will meet synchronously, but I will record lectures. Most weeks, I will present material on Mondays, and we will use Wednesday classes to work on assignments. I will expect (but do not require) that you will collaborate on these, because you learn more that way, and it’s more fun, too.

Assignments will alternate between theoretical (proof-based) written assignments, and lab assignments, which will be more applied, and will make use of the computer. We will do our lab assignments using **Jupyter notebooks** on the University’s [Syzygy](#)⁴ server. These labs will use Python, but not in a programming sense. Throughout the textbook, you’ll find examples of code syntax to do linear algebra calculations.

If circumstances prevent you from attending class during the scheduled time, you will have access to the recordings and the textbook. We use **Campuswire** as a course communication platform. One of its nice features is the ability to set up chat rooms for students who want to work together, but can’t make it to class.

¹moodle.uleth.ca

²www.cs.uleth.ca/~fitzpat/teaching.html

³opentext.uleth.ca

⁴uleth.syzygy.ca

In [Subsection 2.4](#) you're going to see that there are lots of pieces to your grade. And yes, most of them have deadlines. But don't worry! Most of those pieces are small: designed to be done in class, or to take up no more than an hour or so of your time. Learning any kind of math is a marathon, not a sprint. So I'm giving you a little bit to do every day. Keep at it, and you'll do well. (Also, many deadlines are flexible, so don't hesitate to ask if you need more time.)

2.3 Course textbook

Our course textbook is *Lecture Notes for Math 3410* (by me), supplemented by *Linear Algebra with Applications*, by Keith Nicholson.

Both books are **open education resources** (OER). That means that the books are fully free, both in terms of cost, and your freedom to use and share the books however you see fit.

Use the Math 3410 notes as your guide to how we'll proceed through the course material. The Nicholson book provides additional details, along with plenty of exercises and examples.

If getting the book for free somehow feels wrong, or you worry you're missing out by not buying anything, here is a great book you can buy (especially if you're in Education):

[Mathematics for Human Flourishing](#)⁵, by Francis Su.

2.4 Grading scheme

The various graded components of the course are explained below. At first it will seem like there's a lot to do! But most items are small, and many can be done during class time.

Online Homework (20%)	Whenever we're covering a topic for which appropriate problems are available, I'll provide a problem set you can complete, to help develop proficiency with the computational procedures in the course. Homework will be delivered through the WeBWorK online homework system. See Subsection 4.1 for details.
"Lab" assignments (20%)	Lab assignments consist of work that is more computational in nature. They were originally planned as in-class assignments, but due to the labour disruption, we will move this to primarily take-home. Group work is strongly encouraged, and I will make some class time available to answer questions about the labs.

⁵www.chapters.indigo.ca/en-ca/books/mathematics-for-human-flourishing/9780300237139-item.html

Proof Assignments (20%) Assignments will also be done in groups, using the same principles as the lab assignments. The focus of the assignments will be on learning to produce well-structured proofs. Here is a fictitious (but possibly informative) grading rubric for assignments:

- A: wow, they clearly discussed this as a group, and nailed down all the key points! I also appreciate how the work is legible and relatively free of frustrated scribbling.
- B: everyone had something to say, but I'm not sure they all agreed. There's an obvious mistake that someone should have caught, suggesting that nobody thought to read it over before submitting.
- C: most of the details are there but this was clearly done in the last hour before the deadline. Also, it looks suspiciously like one person did all the work.
- D: looks like parts (a), (b), (c), and (d) were each done by a different person, and then arranged randomly on the page.
- F: nothing submitted. Or work is a crude drawing of what appears to be an integral attacking a kitten.

Peer review activities (10%) There will also be individual assignments that cover theory and proof. This will be facilitated through Moodle, using the **Workshop** activity. In a Moodle Workshop, you submit work like you would for a Moodle assignment. But once the submission phase closes, the workshop moves on to a peer feedback phase.

Typically, any reasonable effort at completing these activities will receive full credit. Any peer score over 75% will be automatically rounded up to 100%. I will review anything below 75% to see if the lower score is deserved.

Tests (25%) There will be three tests in total. Tests will open on January 26th, April 6th, and April 27th, and remain open for at least 48 hours.

You will write the test *individually*, and submit via **Crowdmark**. The test will be a take-home test: open book, and open notes. The primary restriction is that you are not allowed to hire someone else to write your test for you. (This includes using certain subscription-based websites that offer "homework help".)

Exam wrappers (5%) After your test has been graded, you will be asked to submit a short reflection piece, where you comment on your performance and the feedback you receive.

Regrading policy:

- All graded work can be revised and resubmitted for extra credit. Corrections should be submitted within one week of work being returned, and you can earn back up to 75% of the points you lost by making corrections.
- If you are confident you know how to fix your mistakes, you can submit corrections via email. If you'd like to discuss your feedback first, we can discuss corrections during student hours. For group work, emails (or student hour appointments) should include the whole group.
- Corrections are based on *feedback*: to revise a question, you must first attempt the question. (Don't leave anything blank.)

Other grading policies:

- In each grade category, I will drop your lowest score. This includes an assignment or test that you missed completely, whether due to illness or the generally overwhelming burden of trying to learn during a pandemic.
- Students are expected to abide by University regulations regarding academic honesty. Use of resources (online or otherwise) is permitted, as long as these are properly cited. Getting someone else to do your work for you is not permitted.
- If we determine that you cheated on an assignment or test (through plagiarism, copying, online “study” sites, etc.) you will receive a grade of zero on that grade item, and you will not be able to “drop” that grade item as your lowest grade in that category.

Each of the grade components above will be assigned a numerical score. These will be added to get a score out of 100. Your score out of 100 is converted into a letter grade according to the following table.

Table 2.1 Conversion of percentage scores to letter grades in Math 3410

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	F
98-100	93-97	90-92	86-89	80-85	77-79	73-76	68-72	64-67	60-63	50-59	0-49

3 Communication

The following communication channels are available in this course:

1. *Forums.*

There will be a primary course Q&A forum using [Campuswire](#)¹. Use of Campuswire is not mandatory (some of you may have privacy concerns) but it is strongly encouraged. Campuswire has a primary class feed, that serves as a Q&A forum. There is support for mathematical notation, code highlighting, and remaining anonymous to your peers when you post.

For groups of students who want to be able to communicate outside of class, it is also possible to set up chat rooms in Campuswire. These can be made private, so that only those who are invited have access.

Campuswire should be your primary communication channel. In particular, any questions about homework and course content should be asked there, since I can reply there with mathematical notation. You will also get a much faster reply on the forum than you will from email. If you have a question you don't want to ask publicly, you can send a direct message instead.

To access Campuswire, use the signup link and PIN code provided on Moodle. But note that to sign up this way, you will need to use your U of L email address. If you prefer not to provide your school email address to a third party company, you can ask me to send you an invite to a different email address.

2. *WeBWork.*

There is one exception to the “put all homework questions on Campuswire” rule: in our WeBWork online homework system, there is an “Email Instructor” button you can click to send feedback. This is useful if you think there's an error in the question, or if you've tried it several times and can't figure out why you're wrong. That email comes with a link I can use to jump directly to your version of the question, and see what answers you've tried. See [Subsection 4.1](#) for details.

¹campuswire.com/

3. *Email.*

You can email me for questions that aren't related to course content. For example, if you have to miss class, or a test, you can email me to let me know. Note that my phone automatically disables email notifications after 5 pm. If you email me in the evening, you should not expect to receive a reply until the next morning.

4 Technology elements

To facilitate online teaching, our course will rely on several technological solutions. This section provides details on navigating the technology.

4.1 Online homework

Online homework is delivered via WeBWorK. WeBWorK is an open source homework system that I maintain on a local server. This service is provided to you free of charge, and your data never leaves campus.¹

The value of WeBWorK is that questions are automatically graded, providing you with immediate feedback on your work. This is an excellent source of guided practice.

To access WeBWorK: simply click the relevant link in Moodle. You will be signed in automatically — there is no user name or password. But keep in mind that if your session times out due to inactivity, you have to return to Moodle to log in again.

Submitting answers: WeBWorK has an automatic preview feature. The mathematics in your answer will be rendered as you type. (You can turn this off in the user settings if you don't like it.) If everything looks good, click the Submit button. The system will immediately respond with "Correct" or "Incorrect". If your answer is correct, there is nothing more to do: your answer has been recorded, and you have credit for that problem. If your answer is incorrect, you get to try again. (*Exception:* I typically do not give unlimited attempts for true/false and multiple choice questions.)

Other notes:

- If you need to include scientific units in an answer, the automatic equation rendering can cause trouble. There's a little tool bar on the right hand side that lets you switch to *text mode* to enter units.
- At the bottom of each page is an "Email Instructor" button. If you are stuck on a problem, or if you think there is an error in the programming (it happens!) you can use this to let me know. WeBWorK will send me an email with your message, along with a link to the exact version of the problem you were working on. Often I can figure out where you're going wrong by looking at your answer.

Please *do not* use the email button to ask me how to solve a problem. That's what the discussion forum is for. It should only be used after you've made several attempts at the problem, or if you see an error message of some sort.

- Your score on WeBWorK updates automatically with Moodle once per day. If you have just completed an assignment, don't expect to see this reflected immediately in the Moodle gradebook.

Finally, some general advice: WeBWorK is not a new addition for the online environment. I've used it for awhile. The students who do well in this course are the ones who start their problem sets early. Please do not wait until the due date to begin: it leaves you no time to ask questions! The most effective way to use WeBWorK is to read the relevant portion of the textbook, try the problems, and then ask for help on the ones you're stuck on.

¹Okay, this is not entirely true. Since faculty are expected to teach from home, your data does travel from campus to my house via the university VPN.

Oh, and please do not wait until you've made 50 unsuccessful attempts at a problem to ask for help. If you haven't figured out a question after 5 or 6 attempts, set it aside, and come back to it a bit later. If you still can't figure it out, go the discussion forum.

4.2 Jupyter and Syzygy

The Python code that appears in the textbook can also be run in a Jupyter notebook. Jupyter notebooks are a great tool for completing a lab assignment with computation, since you can include both regular text (including images, links, mathematics, etc.) and code.

Unlike the Sage cells in the book, a Jupyter notebook lets you save your work, and you can also print it to PDF for submission.

The University of Lethbridge has access to an online Jupyter hub called **Syzygy**, which is available at <https://uleth.syzygy.ca/>². You can sign into Syzygy using your U of L credentials.

4.3 Crowdmark

Tests and assignments will be submitted through Crowdmark. Like WeBWorK, Crowdmark is connected to Moodle, so you just have to click a link in Moodle to access your assessment and submit your work. Unlike WeBWorK, Crowdmark lets you do your work using pencil and paper. For ease of reference, I've placed [advice for using Crowdmark](#)³ on a separate page.

Basic advice:

- Start each question on a clean sheet of paper.
- Use a scanner, or a scanning app on your smartphone. PDF is best, but JPG and PNG files are also supported.
- When you submit, make sure your pages are in order, and rotated correctly.

4.4 Zoom and other video

Classes and tutorials will meet using Zoom. This is the officially supported meeting app for U of L classes, so you'll very quickly become familiar with (and tired of) Zoom.

List 4.1 Zoom guidelines and etiquette

- Sign on using your U of L email and your proper name. I'm hoping to be able to put you into breakout rooms using pre-assigned groups. This will not work if your name doesn't match what's on the class list.
- Please **do** mute your microphone when everyone is together in the main room. You can unmute if you want to ask a question.
- Please **don't** mute your microphone while in a breakout room. (With reasonable exceptions: some of you might be in noisy environments, such as a construction site, or a house with kids.)
- About cameras. I will never require you to turn your camera on. Some of you may have very good reasons why you do not want to turn your camera on, and some of you may not even have a camera to turn on. But if you are willing to turn your camera on, it does help me, since I can use the visual cues you provide to tell if you understand what we're discussing.

²uleth.syzygy.ca/

³www.cs.uleth.ca/~fitzpat/crowdmark.html

When you are working with your group, in a breakout room, please consider turning on your camera, even if you otherwise don't. It makes it much easier to work as a group if you can see each other.

List 4.2 Asking questions during class

1. Using the chat box in Zoom. This is probably most useful to quickly ask for clarification on something I just said.
2. Using your voice! There is a “raise hand” feature if you don't want to interrupt, but it's often perfectly reasonable to interrupt, especially if you notice me getting something wrong!

Group work in Zoom. During most Zoom sessions, you will be put into smaller breakout rooms to work on problems. Breakout rooms are not recorded, and I cannot actively monitor the breakout rooms — these are essentially private working sessions for your group. I *do* have the ability to join a breakout room temporarily, but will only do so when invited. If you need my help during a breakout session, there is an “Ask for help” button you can use to get my attention.

You will be encouraged to use Microsoft OneNote to collaborate with your group. OneNote lets you type notes, insert photos, and use handwriting, if you have a touch-enabled device. Unlike the Zoom chat and whiteboard features, your OneNote notebook will remain available after class for you to refer to. See [Subsection 4.5](#) for more details.

Recording. First of all: I do not intend to record entire Zoom meetings. I will record parts of class where I am presenting an example or exercise. However, I will not do this using Zoom's recording feature. Instead, I will record the same screen that I am sharing with you in Zoom using other software. This way, student images and voices will not be captured in the videos. Any videos I record will be uploaded to Moodle using the **YuJa** platform.

Please be aware that it is an *academic offence* to record a class, or anyone in it, without prior authorization. If all members of a breakout room agree to having someone record your discussion, this is fine. When are in the “main room” of Zoom, recording is not permitted.

4.5 Using OneNote

OneNote will be used both for class presentations, and for student collaboration. Details here will include how to access class notebooks, how to edit collaboratively, how to print, etc..

Students will have access to OneNote through their Office 365 accounts. There were early promises of Moodle integration that don't seem to have worked out. What we got instead are class “teams” on Microsoft Teams. There's one team per section, and each team has a class notebook attached to it.

5 Course policies (an FAQ)

This section deals with questions about accommodations, missed tests, and other exceptional (yet common) cases.

1. *I don't think I can attend the classes regularly. Can I still take the course?*

Short answer: yes. I recognize that not all students have access to the same technology. If your home internet is unreliable, attending Zoom sessions could be a challenge. If

you can't attend synchronous sessions, I will arrange alternatives for graded work done asynchronously. I will also try to connect you with other students in the same situation, so that you still have a group you can work with.

2. *What happens if I get sick?*

I'll do my best to be accommodating of any illness that interrupts your studies. There is no need to provide details of the illness. If you miss a week or more of work, please get in touch to make a plan for catching up. One of the biggest challenges in math is that once you fall behind, it's difficult to catch up on your own.

3. *What exactly does academic honesty mean?*

In short, that any work you represent as your own, is your own. Much of your work can be done in groups, but not all of it. I will assume that you have access to a calculator, including online tools (like [Symbolab](#)¹) that give you step-by-step solutions.

Use of these tools is acceptable, but take care that you are not overly reliant on them. What is not acceptable is having someone else do your work for you. This includes tutors, classmates, friends, family members, and online "homework help" sites. If you find yourself submitting an assignment without having learned the material, there is a good chance you have committed an academic offence.

Penalties for academic dishonesty are outlined in the [Academic Calendar](#)². Depending on the severity of the offence, penalties for a first offence can range from a grade of zero on an assessment, to an F in the courses. Academic offences are also reported to the Dean of Arts & Sciences. They keep a record of each offence, and students with multiple offences can be subject to supplementary discipline.

4. *Does that mean I'm not allowed to get help with my homework?*

Not at all! But keep in mind that your course instructors will be available for help, free of charge. (OK, maybe not free of charge, but you've already paid for it with your tuition.) We will be responding on the discussion forum regularly, There will be time to ask questions in every class, and there will be online office hours. The Student Success Centre will also be running free help sessions (details TBA).

Some of you may still decide to pay for tutoring, and that's fine. But you have a duty to disclose sources of help on an assignment, and the individual tests are still tests, even if you won't have someone watching over your shoulder.

You should probably avoid the various paid "homework help" websites. Most of these don't offer help. They offer worked solutions for a price. Getting those solutions won't help with your understanding. More importantly, the people working for these sites are paid (poorly) per solution, and they often provide incorrect and/or badly written work. (We saw plenty of examples of this last Spring, and yes, all those students now have discipline reports on file.)

5. *I missed a test! What do I do? Do I get a zero?*

First, contact me as soon as possible for any missed test. There are *five* tests, and I only count *four* towards your grade. As long as you only miss one test, there is no penalty. This is true regardless of your reason for missing the test.

6. *Do I need a doctor's note?*

No. This wastes health care resources and your time. (That was my answer before the pandemic, and it's doubly so now.) Just email me to say you were sick. However, if you miss more than one test due to illness, we'll need to meet to discuss how to adjust your grade.

¹www.symbolab.com/

²www.uleth.ca/policy/resources/student-discipline-policy-academic-offences-undergraduate-students

7. *I receive learning accommodations. What arrangements can I make?*

First, make sure that you have registered with the University's [Accommodated Learning Centre](#)³. No need to let me know: they notify me of every student with accommodations.

If there are any adjustments I can make to facilitate your learning, please do not hesitate to get in touch with me. All students deserve an equal opportunity to learn. Note that the HTML textbook is designed with accessibility in mind, and should work with screen readers. However, I regret that we have not had the time (or paid help) necessary to add elements such as alt-text descriptions for images. It's on the to-do list, but that list is long, and growing.

8. *Life intervened and I can't keep up this week. What do I do?*

Send me an email. Extensions are usually granted as long as they're granted ahead of time. Online homework extensions need to be in place before solutions become available. Book an appointment with me as soon as you feel like you're falling behind and I'll do my best to get you up to speed.

6 Course schedule

I will attempt to follow the schedule below, bearing in mind that some adjustments are always needed, and this is probably more likely as we attempt to navigate an online environment. Numbers below refer to textbook sections.

Online homework assignments will be due on Tuesdays. Assignments and labs will be done in class on Wednesdays. Tests will run from Wednesday to Friday.

Sections below refer to my online lecture notes.

Table 6.1 Schedule for Spring 2022

Monday	Wednesday	Assessment
Jan. 10: 1.1, 1.2	Jan. 12: 1.3, 1.4	Lab 1
Jan. 17: 1.3, 1.5	Jan. 19: 1.5	Asst. 1
Jan. 24: 1.6	Jan. 26: 2.1	Asst. 2, Test 1
Jan. 31: 2.1, 2.2	Feb. 02: 2.2, 2.3	Lab 2
Feb. 07: 2.3	Feb. 09: 2.4	Oops. Strike.
	Mar. 23: 2.4	Re-orientation
Mar. 28: 3.1	Mar. 30: 3.2	Lab 3
Apr. 04: 4.1	Apr. 06: 4.2	Test 2
Apr. 11: 4.4	Apr. 13: 4.5	Asst. 3
Apr. 18: Easter	Apr. 20: 5.1	Lab 4
Apr. 25: 5.2	Apr. 27: 5.3	Test 3

There are classes scheduled for May 2nd and 4th. I am not scheduling anything for those dates. However, if there are a few students interested in going over the material in 5.4 and 5.5, we could hold an optional class on May 2nd.

³www.uleth.ca/ross/accommodated-learning-centre