Course Guidelines
University of Puget Sound
Dr. Beezer

Linear Algebra
Math 290A
Spring 2021

Texts

We will be using *A First Course in Linear Algebra*, by Robert A. Beezer as our textbook. The most recent public version is Version 3.50 and may be found as a PDF on the book's site at linear.pugetsound.edu, where it is made freely available with an open license. If you prefer, you can use the hardcover version, which is Version 3.00, but this will have major differences in Chapters D and E. See the book's site for information on ordering a physical copy.

The online version of Version 3.50 is at linear.pugetsound.edu/fcla. This has the subtitle "(Beta Version)" presently, and is not the older green-themed version. You may find this version the most useful, and it will also perform well on a mobile device.

However, for this course, this term, we will be using a special "enhanced" and modified version online, which will be discussed in class.

The course web page has some recommendations for open textbooks about proof techniques, which will augment the shorter discussions in the textbook.

Course Web Page

Off of buzzard.ups.edu/courses.html you can find the link to the course web page.

Office Hours

Office Hours will be online, via Zoom, by appointment. Monday, Thursday and Friday mornings I am in class, and the remainder of weekdays I should be available. Making appointments or simple, **non-mathematical** questions can be handled via email—my address is beezer@ups.edu. I rarely do not receive your email, and I read all of my email all of the time, usually very shortly after receiving it. Urgency of replying varies by the hour, day and nature of the message. Please do not use email for any question that requires a **mathematical** reply. Email is not a good medium for discussing mathematics.

Computation

Linear algebra is at the heart of many large computations in computer science, physics, chemistry, economics, statistics, and other disciplines. So it is useful to become familiar with relevant software. Futhermore, freed from doing error-prone numerical computations you can concentrate on new ideas and concepts.

For both reasons, we will make extensive use of Sage. Since Sage is open source software, it is available freely in many places. We will be relying this semester on hosted versions at CoCalc, cocalc.com. You already have a course project associated to your UPS email address and by the "last day to drop" you will need to pay $14 (for the entire semester) so you can move your course project to a members-only server.

There are thorough discussions about Sage integrated into the web version of your textbook. We will discuss in class the use of Sage during examinations. In particular, if you do not own a laptop, investigate procedures **now** for borrowing one from the library.

Homework

There is a nearly complete collection of exercises in the text. Any (or all) of the problems will be good practice as you learn this material. Many of these problems have complete solutions in the text to further aid your understanding. Of course, you are not limited to working **just** these problems.

None of these problems will be collected, but instead they will form the basis for our fourteen "Problem Sessions" and for discussions at Office Hours. It is your responsibility to be certain that you are learning from these exercises. The best ways to do this are to work the problems diligently as we work through the sections (see attached schedule) and to participate in the classroom discussions. If you are unsure about a problem, then a visit to my office is in order. Making a consistent effort outside of the classroom is the easiest way to do well in this course.

> Mathematics not only demands straight thinking, it grants the student the satisfaction of knowing when he [or she] is thinking straight.
>
> —D. Jackson

> Mathematics is not a spectator sport.
>
> —Anonymous

> I hear, I forget. I see, I remember. I do, I understand.
>
> —Chinese Proverb

> An education is not received. It is achieved.
>
> —Anonymous

Examinations

There will be seven 50-minute timed exams—they are all listed on the **tentative** schedule. The lowest of your seven exam scores will be dropped. There will be a comprehensive final exam, but a time has not been set by the Registrar. The final exam cannot be given at any other time and also be aware that I may allow you to work longer on the final exam than just the two-hour scheduled block of time. In other words, ***plan your travel arrangements accordingly.***

As a study aid, I have posted copies of old exams on the course web site. These are offered with no guarantees, since techniques, approaches, emphases, and even notation will change slightly or radically from semester to semester. Some of the solutions contain mistakes, and

some of the problem statements have typos. In other words, they are not officially part of this semester's course and I do not maintain them. In particular, I do not advocate working old exams as a primary, or exclusive, technique for learning the material in this course. **Use at your own risk**: they have not been reviewed for minor mistakes or inconsistencies with this semester's course. I will not entertain questions about the correctness of these materials via email.

Come to examinations prepared to remain in the room for the entire length of the exam. Power off any electronic devices (this includes phones).

Writing

This course has been designated as part of the University's Writing in the Major requirement. Thus, there will be two proofs assigned for each chapter. You will be expected to formulate a proof, and write it up clearly. These will be graded on a pass/fail basis. Each chapter's questions will be returned to you with careful comments, and if you do not earn a Pass, then you can resubmit them at the close of the next chapter. You may resubmit a problem for several consecutive chapters in a row, **so long as you make a serious effort on each outstanding problem at each opportunity**. Once you miss an opportunity to resubmit, or a retry does not contain any new work, or significant comments and hints are ignored, then it will be scored as a No Pass. Failure to follow the directions for submitting these can result in an automatic retry with no feedback. Please read the instructions and details provided with these problems very carefully.

Due dates will be announced in class, generally at the end of a chapter and prior to that chapter's exam. Under no circumstances will they be accepted late. During the first part of the course, we will learn the mathematical typesetting software, LaTeX, and you will be required to use this tool appropriately when writing your proofs, and you may be required to do a retry soley on the basis of incomplete use of LaTeX. I might request your LaTeX source as part of grading your exercises, so make sure you retain these.

These problems ***ARE YOUR OWN WORK***. In other words, no collaboration on formulating the proof, no collaboration on writing the proof, no copying content from the book's source, and no discussion **whatsoever** with classmates or others familiar with the subject or the exercises. In particular, I do not provide consultation in advance of submission, but rather will provide careful comments on your written submitted work. Late submissions will not be accepted, and forfeit your opportunity to submit retries.

Reading Questions

Each section of the textbook contains three reading questions at the end. Once you have read the section **prior** to our in-class discussion, it will be time to consider these questions. Responses will be due by 6 AM of the day we discuss the section in class, and will not be accepted late. If a question asks for a computation, then provide a complete answer, perhaps with some relevant intermediate computations. If the question requests a yes/no answer, or asks "Why?" then give a thorough explanation using correct English grammar, syntax, and punctuation along with appropriate use of LaTeX. Cutting and pasting from the textbook without a citation is always plagiarism. And even providing a verbatim quote along with a citation will always get you zero credit.

Runestone information:

- Log in at runestone.academy
- Your username is the **first part** of your UPS email address—everything up to, but not including, the @ character.
- Your **initial** password is your UPS ID number (7 digits, starts with a 5).
- Reading questions are towards the bottom, in a subsection of their own.
- The text box will interpret LaTeX notation, so as we learn how to use LaTeX you will be expected to format your answers properly.
- My responses will appear here in the problem itself as well, shortly after they are due.

Grades

Grades will be based on the following breakdown:

- Reading Questions: 10%
- Writing: 15%
- Examinations: 55%
- Final Examination: 20%

Attendance and improvement will be considered for borderline grades. Scores will be posted anonymously on the web at a link off the course page.

Academic Policy Reminders

Here are three reminders about important academic policies which are described thoroughly in the "Academic Policies" section of the *University Bulletin*. The online version is off of

www.pugetsound.edu/academics/academic-resources/university-bulletins/

or a printed copy may be requested from the Registrar's Office (basement of Jones Hall).

- *Registration for Courses of Instruction, Non-Attendance.*

  "Regular class attendance is expected of all students. Absence from class for any reason does not excuse the student from completing all course assignments and requirements."

- *Grade Information and Policy, Withdrawal Grades.*

  Withdrawal grades are often misunderstood. A Withdrawal grade (W) can only be given prior to the university deadline listed on our course schedule, and after that time (barring unusual circumstances), the appropriate grade is a Withdrawal Failing (WF), **even if your work has been of passing quality**. See the attached schedule for the last day to drop with an automatic 'W'.

- *Academic Integrity.*

  All of your graded work is expected to be ***entirely*** your own work, this includes Reading Questions and Writing Exercises. Anything to the contrary is a violation of the university's comprehensive policy on Academic Integrity (cheating and plagiarism). Discovered incidents will be handled strictly, in accordance with this policy. Penalties can include failing the course and range up to being expelled from the university.

Purpose

This course is much different from most any mathematics course you have had recently, in particular it is much different than calculus courses. We will begin with a simple idea—a linear function—and build up an impressive, beautiful, abstract theory. We will begin computationally, but soon shift to concentrating on theorems and their proofs. By the end of the course you will be at ease reading and understanding complicated proofs. You will also be very good at writing routine proofs and will have begun the process of learning how to create complicated proofs yourself.

You will see this material applied in subsequent courses in mathematics, computer science, chemistry, physics, economics and other disciplines (though we will not have much time for applications this semester). You will gain a "mathematical maturity" that will be helpful as you pursue upper-division coursework and in any logical, rational, or argumentative activity you might engage in throughout your lifetime. It is not easy material, but your attention and hard work will be amply repaid with an in-depth knowledge of some very interesting and fundamental ideas, in addition to beginning to learn to think like a mathematician.

Conduct

Virtual: Please find a quiet place with a good connection to attend online sessions, so that we might better have questions and discussions. I appreciate it if you can leave your camera on—please contact me privately if this is a problem. Please do not use chat to ask questions, or to talk to one another. You can use chat to be recognized with a question, or simply hold up your physical hand close to your camera.

In-Person: Daily attendance is required, expected, and overall a pretty good idea. Class will begin on-time, so be here, settled-in, and ready to go. In other words, walking in the door at the exact time class is to begin is not considered being on-time. Repeated tardieness and absences will result in grade penalties, in accordance with university policies. Do not leave class during the lecture unless remaining would be a greater distraction—fill your water bottles, use the toilet, and so on, **IN ADVANCE**. Come to class prepared to be attentive for 50 minutes. Mask-wearing is required at all times. Do not bring food or drink since you would need to remove your mask to consume it. Please keep phones in your pocket or bag, unless you are using them to read course material. In short, we are here to learn and discuss mathematics. It is your responsibility to not distract your peers who are serious about their education, or distract me as I endeavor to make the best use of the class time for everybody.

University Notices

These are multiple notices the university administration requests we duplicate for you.

- *Classroom Emergency Response Guidance.*

  Please review university emergency preparedness, response procedures and a training video posted at www.pugetsound.edu/emergency/. There is a link on the university home page. Familiarize yourself with hall exit doors and the designated gathering area for your class and laboratory buildings.

  If building evacuation becomes necessary (e.g. earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.

  If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Lie on the floor out of sight and away from windows and doors. Place cell phones or pagers on vibrate so that you can receive messages quietly. Wait for further instructions.

- *Student Religious Accommodation.*

  The university provides reasonable religious accommodations for academic courses and programs, and the university policy is found at this location[1]. If you need a reasonable accommodation due to a religious holiday or organized religious activity, you must give me written notice within the first two weeks of class so that we can coordinate the accommodation. If you have questions about the policy, you may contact the University Chaplain. If you have a grievance about the application of the policy or the handling of your request for an accommodation, you may contact the Dean of the Faculty.

Learning Outcomes

The University Curriculum Committee and accrediting agencies expect to see a list of learning outcomes.

- Understand vector spaces.
- Understand linear transformations between vector spaces.
- Understand that every vector space is isomorphic to the coordinate vector space over its base field.
- Understand that every linear transformation can be represented by a matrix.
- Understand that matrix multiplication is composition of linear transformations.
- Understand that matrix diagonalization is achieved through a similarity transformation and is a matrix representation relative to a basis of eigenvectors.

[1] www.pugetsound.edu/about/offices-services/human-resources/policies/campus-policies/student-religious-accommodations-in-academic-courses-or-programs

- Understand that eigenvalues are a property of a linear transformation and are independent of its representation as a matrix.
- Better understand the general concept of an **algebraic structure**.

Please review these at the **end** of the semester when they will be easier to understand.

Tentative Daily Schedule

Monday	Tuesday	Thursday	Friday
Jan 18 MLK Day	Jan 19 Section WILA Syllabus CoCalc	Jan 21 Section SSLE LaTeX	Jan 22 Section RREF LaTeX
Jan 25 Section TSS LaTeX	Jan 26 Problem Session LaTeX Elect CR/NC	Jan 28 Section HSE LaTeX	Jan 29 Section NM LaTeX
Feb 1 Problem Session Writing SLE Drop w/o Record	Feb 2 Exam SLE	Feb 4 Section VO	Feb 5 Section LC
Feb 8 Section SS	Feb 9 Problem Session	Feb 11 Section LI	Feb 12 Section LDS
Feb 15 Section O	Feb 16 Problem Session Writing V	Feb 18 Spring Break 1	Feb 19 Spring Break 2
Feb 22 Section MO	Feb 23 Exam V	Feb 25 Section MM	Feb 26 Section MISLE
Mar 1 Section MINM	Mar 2 Problem Session	Mar 4 Section CRS	Mar 5 Section FS
Mar 8 Problem Session Writing M	Mar 9 Exam M	Mar 11 Section VS	Mar 12 Section S

Mid-Term

Tentative Daily Schedule

Monday	Tuesday	Thursday	Friday
Mar 15 Section LISS	Mar 16 Problem Session	Mar 18 Section B	Mar 19 Section D
Mar 22 Section PD	Mar 23 Problem Session Writing VS	Mar 25 Section EE	Mar 26 Section PEE
Mar 29 Spring Break 3	Mar 30 Spring Break 4	Apr 1 Section IS	Apr 2 Problem Session
Apr 5 Section SD	Apr 6 Exam VS	Apr 8 Section CP	Apr 9 Problem Session
Apr 12 Section LT	Apr 13 Exam E	Apr 15 Section ILT	Apr 16 Section SLT Last Day to Drop w/ a W
Apr 19 Section IVLT	Apr 20 Problem Session Writing LT	Apr 22 Section VR	Apr 23 Section MR
Apr 26 Problem Session	Apr 27 Exam LT	Apr 29 Problem Session	Apr 30 Section CB
May 3 Problem Session Writing R	May 4 Exam R	May 6 Reading Period	May 7 Reading Period

Final Examination: TBA