Instructor Name	Aimé Fournier
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Instructor E-mail	aime.fournier@ucdenver.edu
Department	Mathematical and Statistical Sciences
College	Liberal Arts & Sciences
Website	https://ucdenver.instructure.com/courses/371860
Class Location	Plaza 112
Class Meeting Time	Tuesday, Thursday 11 am–12:15 pm
Office Hours	Tuesday 13:00–13:50, Thursday 10:00–10:50 or by appointment, or dropping in
Term	Spring

COURSE OVERVIEW

I. Welcome!

In practice, many mathematical problems cannot be solved by hand calculations, but must be solved numerically. That is, they are solved by iterating hand (or usually, computer) calculations to approach the problem solution. For example, $x \mapsto (x+s/x)/2$ was discovered to iterate eventually to $\sqrt{s}$, more than 1900 years ago! Numerical analysis is the invention and study of algorithms for such calculations.

II. University Course Catalog description

Methods and analysis of techniques used to resolve continuous mathematical problems on the computer. Solution of linear and nonlinear equations, interpolation and integration. Prereq: MATH 2411, 3191 or 3195, and programming experience. Cross-listed with CSCI 4650, 5660, and MATH 5660. Semester Hours: 3 to 3. See Listing of core courses.

III. Short description of the course

The main topics of Numerical Analysis (NA) are: how best to translate mathematical definitions, formulas etc. into computational algorithms, methods etc.; the unifying principles that lead to best translations e.g., convergence, conditioning, and complexity; and examples of NA applications in science and engineering.

IV. Course objectives & learning outcomes

- To recognize, operate on and convert between various numeric models.

- To understand and remedy sources of computation error.

- To estimate and distinguish between problem conditioning and algorithm stability.

- To solve algebraic and transcendental equations.

- To solve multivariate and nonlinear equations.

- To interpolate values of a function from its samples.

V. Prerequisites

This course assumes that students have taken Math 2411 and either 3191 or 3195, and have some programming experience. We will spend the first two days reviewing and testing students' understanding of required results from linear algebra. Complete facility with these results is required to do well in this course.

VI. Course credits Max hours: 3 Credits.

VII. Required text

Timothy Sauer, *Numerical Analysis,* 3rd Edition, 2011. Published by Pearson: ISBN-10 0-134-69645-X; ISBN-13 978-0-134-69645-4. Read the textbook sections to be covered before the class: even if you may not understand everything, it makes the class much easier.

VIII. Supplementary materials

- Textbook website

- Wikipedia on Numerical Analysis

- Wolfram Alpha is a powerful tool to verify symbolic calculations, including some numerical analysis, but no substitute for learning how to do it by hand.

IX. Course schedule See Table 1

EVALUATION

X. Assignments

Assignment Problems appear in the schedule (§IX) to guide preparation for quizzes, but will not be marked up or graded. Doing homework is still vital to learning the material in this class. Expect to spend ≈9–12 hours/week on the homework and studying. Success will not come from only listening to lectures or reading the book. Spend your time wisely: if you find yourself working on one problem for more than 10 minutes without progressing, then move on to another problem and return to the challenging problem later. If you're getting stuck on all the problems, then it is time to:

- talk with a classmate,

- come to Prof. Fournier's office hours, or

Date	Topic	Reading	Assessment due	Progress to total grade
1/16,18	Fundamentals	0.1–4	Linear Algebra quiz	4%
1/23,25	Solving Equations	0.5, 1.1–2	0: 1.2, 2.4, 3.4, 4.2	
1/30, 2/1		1.3–5	0: 5.6	
			1: 1.2, 2.32	
2/6,8	Systems of Equations	2.1–2	1: 3.2, 4.16, 5.6	
			Solving Eqs. quiz	16%
2/13,15		2.3–4	2: 1.6, 2.6	
2/20,22		2.5–6	2: 3.2, 4.6	
			Stewart Platform Project	28%
2/27, 3/1		2.7	2: 5.2, 6.2	
			Systems of Eqs. quiz	40%
3/6,8	Interpolation	3.1–2	2: 7.4	
3/13,15		3.3–4	3: 1.2, 2.2	
			Euler-Bernoulli Beam Project	52%
3/27,29		3.5	3: 3.2, 4.4	
			Interpolation quiz	64%
4/3,5	Least Squares	4.1–2	3: 5.4	
4/10,12		4.3–5	4: 1.8, 2.2	
4/17,19	Numerical Differentiation and Integration	5.1–2	4: 3.8, 4.2, 5.2	
			Least Squares quiz	76%
4/24,26		5.3–4	5: 1.12, 2.8	
			GPS Project	88%
5/1,3		5.5, Review	5: 3.2, 4.2, 5.2	
5/8,10			Final Exam (dates tentative)	100%

Table 1: Schedule (see Canvas for updates). Quiz and exam dates are underlined, and during these no electronic aids are permitted without approval by Prof. Fournier. Quiz dates may change —students should discuss potential unavailability dates with Prof. Fournier before booking travel etc.

- start or reply to a Canvas Discussion to engage with either Prof. Fournier or a classmate.

Note that office-hours discussions are even more casual and adaptive to students learning needs than lectures are. Also see the Intellectual Wellness and Academic Success web site.

Quiz questions will be very similar to assignment questions, or unassigned questions in the same sections as assigned questions.

XI. Basis for Final Grade

After 1/18, raw scores will accumulate over multiple assessments worth 12% each into a total score, as listed in table 1 column 5. Finally, total scores g imply letter grades, based on this table. If many scores seem unexpectedly low, scores may be slightly curved upward, uniformly across all students.

$92\% \leq g$	A
$90\% \leq g < 92\%$	A$-$
$88\% \leq g < 90\%$	B+
$82\% \leq g < 88\%$	B
$80\% \leq g < 82\%$	B$-$
$78\% \leq g < 80\%$	C+
$72\% \leq g < 78\%$	C
$70\% \leq g < 72\%$	C$-$
$68\% \leq g < 70\%$	D+
$62\% \leq g < 68\%$	D
$60\% \leq g < 64\%$	D$-$
$g < 60\%$	F

XII. Grade Dissemination

All assessment grades will be posted in Canvas. During the course, when requested, current grade status will be estimated.

COURSE PROCEDURES

XIII. Course Policies

Attendance Class attendance is recommended, but will not be specifically counted towards students' grades. A few absences are acceptable, but advance notice to Prof. Fournier would be courteous. Class participation will not be specifically counted towards students' grades, but is strongly recommended, to help learn the material from different points of view, and to provide context for evaluating students' written work. UC Denver Student Attendance and Absences Policy: `http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/OAA/StudentAttendance.pdf`.

Late Work Late work will not be accepted without advance approval from Prof. Fournier. There are no make-ups for quizzes or the final exam.

Extra Credit None.

Incompletion The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course; students have up to one year (three semesters) to complete course requirements. Your instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished within the time allowed or the "I" will automatically be recorded as an "F" on your transcript.

Resubmission Work may not be resubmitted. Students are encouraged to go over work with Prof. Fournier before submitting.

Group Work Working together <u>on homework</u> is encouraged —but don't simply copy another's work!

XIV. Technology and Media

E-mail E-mail is preferred over Canvas Conversations. Students should use their university e-mail accounts to communicate with Prof. Fournier about this course.

Canvas Canvas will be used mainly for its Announcements and Discussions features, including comments, suggestions <u>and modifications</u> regarding: due dates, homework, lectures, quizzes, other and schedule items. Raw assessment scores will be tabulated in the Grades section, but current estimate grades may be presented in Discussions (in anonymous form) and by e-mail as individuals request them.

Laptops Laptop use is encouraged <u>outside</u> of class. A student wishing to use a laptop during class e.g., to look up something relevant to the class discussion, must ask Prof. Fournier to approve the use.

Mobile Devices See Laptops. Mobile devices must be silenced during all class meetings. Phone conversations and texting during class are <u>not</u> permitted. Emergency conversations and texting must be taken outside the class.

Calculators Calculators of any kind are permitted but <u>not</u> during quizzes or the Final Exam.

Clickers Clickers are not used in this course.

XV. Student Expectations

Civility My commitment is to create a climate for learning characterized by respect for each other and the contributions each person makes to class. I ask that you make a similar commitment.

Late Arrivals Regarding late arrivals and early departures, advance notice to Prof. Fournier regarding would be courteous.

Religion Students are expected to notify Prof. Fournier in advance if they intend to miss class because of religious observances.

CARE The Campus Assessment, Response & Evaluation Team (http://www.ucdenver.edu/CARE) addresses health and safety needs of the campus community. The purpose of the team is to assess if individuals pose a risk to themselves or others, to intervene when necessary and, more generally, to identify and provide assistance to those in need. The team takes a preventive approach to risk assessment by offering resources, referrals, and support to both the concerning individual and those impacted by their behavior.

E-Cigarettes E-cigarettes are prohibited indoors and $\leq$25 feet from any entrance (http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/Admin/Smoke-Free.pdf).

UNIVERSITY POLICIES

XVI. Disability Access

CU Denver is committed to providing reasonable accommodation and access to programs and services to persons with disabilities. Students with disabilities who want academic accommodations must register with the Disability Resources and Services (DRS) in Academic Building 1, #2116, Phone: 303-315-3510, Fax: 303-315-3515. Prof. Fournier will be happy to provide approved accommodations, once you provide him with a copy of DRSs letter.

XVII. Academic Honesty

Cheating or other academic misconduct will result in no credit for the quiz, or exam in question, plus lowering the overall class grade by 10%, and will be reported to the department chair for further administrative action. For suggestions on ways to avoid academic dishonesty, please see the Academic Honesty Handbook at http://www.ucdenver.edu/faculty_staff/faculty/center-for-faculty-development/Documents/academic_honesty.pdf. Also see below.

XVIII. Important Dates

See the College of Engineering and Applied Science Drop Policy Also see below.

College of Liberal Arts and Sciences
UNIVERSITY OF COLORADO **DENVER**

Spring 2018 CLAS Policies and Deadlines
CLAS Academic Advising Office • NC1030 • 303-315-7100

Academic Policies

The following policies, procedures, and deadlines pertain to all students taking courses in the College of Liberal Arts and Sciences (CLAS). They are aligned with the Official University Academic Calendar found on the Registrar's website.

Schedule Verification

It is each student's responsibility to verify that their official registration and schedule of courses is correct in UCDAccess (*not* Canvas) before courses begin and by the university census date. Failure to verify schedule accuracy is not sufficient reason to justify post-census date adds. Access to a course through Canvas is not evidence of official enrollment.

Email

Students must activate and regularly check their official CU Denver email account for university related messages. Note: Canvas is not the location to access your CU Denver email account. Log into http://www.ucdenver.edu/email/Pages/login.aspx

Administrative Drops

Students may be administratively dropped if they do not meet the pre- and/or co-requisites for a course as detailed in the UCDAccess registration system. Students may also be administratively dropped from a course if the course syllabus articulates attendance expectations prior to census date and they do not meet those attendance expectations. Please note: this procedure does not apply to all courses and students should not rely upon it; if students plan to no longer complete a course, they are responsible to drop or withdraw from the course.

Post-Census Date Adds and Late Withdrawals

Post-census date adds (i.e., adding a course after census date) require a written petition, verifiable documentation, and dean's approval via CLAS Advising. Late withdrawals (i.e., withdrawing from one or more full-semester courses after the withdrawal deadline but before the late withdrawal deadline) require a Late Withdrawal Petition submitted to CLAS Advising (NC 1030 – 303-315-7100). If petitioning to late-withdraw from individual courses, instructor signatures are required. If petitioning to late-withdraw from the entire semester, instructor signatures are not required. Contact CLAS Advising (NC 1030 – 303-315-7100) for more information on post-census date adds and late withdrawals.

Co-Requisites and Drops/Withdrawals

Students dropping a course with co-requisite(s) before or by census date must drop the course and co-requisite(s). After census date, students withdrawing from a course with co-requisite(s) before or by the withdrawal deadline must withdraw from the course and co-requisite(s). After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course or co-requisite(s) based on instructor permission and approval of a Late Withdrawal Petition.

Waitlists

The Office of the Registrar notifies students via their CU Denver email account if they are added to a course from a waitlist. Students will have access to Canvas when they are on a waitlist, but this does not indicate that the student is officially enrolled or guaranteed a seat in the course. If a student is not enrolled in a course after waitlists are purged, instructor permission is required for the student to enroll in the course. The student must complete a Late Add Form and submit it to the Registrar's Office (SCB 5005) by census date in order to enroll in the course.

Applicable Forms

Schedule Adjustment Form   **Submit to Registrar (SCB 5005)**

Purpose:	Approval Signatures Required:	Dates:
Receive an academic overload	*Student and CLAS Advising signatures*	*before Jan. 31 (5pm)*
Receive a time conflict override	*Student and instructor signatures*	*before Jan. 31 (5pm)*
Designate a course pass/fail or no credit	*Student signature*	*before Jan. 31 (5pm)*
Withdraw from an intensive course before the withdrawal deadline	*Student signature*	*Feb. 1 – April 1 (5pm)*

Late Add Form   **Submit to Registrar (SCB 5005)**

Purpose:	Approval Signatures Required:	Dates:
Add a course after the add deadline but before census date	*Student and instructor signatures*	*Jan. 22 – Jan. 31 (5pm)*

Post-Census Date Add Petition   **Visit CLAS Advising (NC 1030) for more information**

Purpose:	Approval Required:	Dates:
Petition to add one or more full-semester courses after census date (verifiable documentation required)	*Submitted petitions are reviewed by the CLAS Assistant Dean*	*after Jan. 31*

Late Withdrawal Petition   **Submit to CLAS Advising (NC 1030)**

Purpose:	Approval Signatures Required:	Dates:
Petition to late-withdraw from a course after the withdrawal deadline but before the late withdrawal deadline	*Student and instructor signatures*	*April 2 – May 2 (5pm)*
Petition to late-withdraw from <u>all courses</u> in the semester after the withdrawal deadline but before the late withdrawal deadline	*Student signature*	*April 2 – May 2 (5pm)*

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Spring 2018 CLAS Policies and Deadlines
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	Academic Calendar
January 16	**Beginning of Semester** – First day of classes.
January 21 (11:59 pm)	**Add Deadline** – Last day to add or waitlist a course using UCDAccess. After the add deadline but before census date, instructor permission on a Late Add Form is required to add courses.
January 22 (11:59 pm)	**Drop Deadline** – Last day to drop a course without $100 drop fee, including section changes (i.e., changing to a different section of the same course). Students may drop courses using UCDAccess. **No Adding of Courses is Permitted Today** **Waitlists Purged –** All waitlists are eliminated today. Students should check their schedule in UCDAccess to confirm the courses in which they are officially enrolled. Canvas does not reflect official enrollment.
January 31 (5 pm) Census Date	**Final Add Deadline (Instructor Permission Required)** Last day to add full-semester courses. To add a full-semester course between the first add deadline and census date, instructor permission on a Late Add Form is required. Students may submit a completed Late Add Form to the Registrar's Office (SCB 5005). After census date, a written petition, verifiable documentation, and dean's approval via CLAS Advising (NC 1030 – 303-315-7100) are required to add a full-semester course. If a student's post-census date add petition is approved, the student will be charged the full tuition amount. College Opportunity Fund (COF) may not apply to courses added late, and these credits may not be deducted from students' lifetime hours. **Final Drop Deadline** Last day to drop full-semester courses with a financial adjustment. Each course dropped, including section changes, between the first drop deadline and census date generates a $100 drop fee. Students may drop courses in UCDAccess. After census date, withdrawal from courses appears on transcripts with a grade of "W," and no financial adjustment is made. After census date but before the withdrawal deadline, students may withdraw from full-semester courses using UCDAccess (instructor permission is not required). **Graduation Application Deadline** Last day to apply for graduation. Undergraduates are expected to make an appointment to see their academic advisors before census date to apply for graduation. Graduate students must complete the Intent to Graduate and Candidate for Degree forms. **Pass/Fail, No Credit Deadline** – Last day to request No Credit or Pass/Fail grade for a course using a Schedule Adjustment Form.
March 19 – 25	**Spring Break** – No classes. Campus open.
April 1 (11:59 pm)	**Withdrawal Deadline** After census date, students may withdraw from full-semester courses using UCDAccess (instructor permission is not required). To withdraw from an intensive course, students may use a Schedule Adjustment Form. Withdrawal from courses appears on transcripts with a grade of "W" and no financial adjustment is made. After the withdrawal deadline but before the late withdrawal deadline, students may late-withdraw by submitting a Late Withdrawal Petition to CLAS Advising (NC 1030 – 303-315-7100). Contact CLAS Advising (NC 1030 – 303-315-7100) for more information. After census date, students withdrawing from a course with co-requisite(s) before or by the withdrawal deadline must withdraw from the course and co-requisite(s). After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course or co-requisite(s) based on instructor permission and approval of a Late Withdrawal Petition.
May 2 (5 pm)	**Late Withdrawal Deadline** Last day to petition to late-withdraw from one or more full-semester courses. Students may petition to late-withdraw by submitting a Late Withdrawal Petition to CLAS Advising (NC 1030 – 303-315-7100). If petitioning to late-withdraw from individual courses, instructor signatures are required. If petitioning to late-withdraw from the entire semester, instructor signatures are not required. Contact CLAS Advising (NC 1030 – 303-315-7100) for more information. After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course with co-requisite(s) based on instructor permission and approval of a Late Withdrawal Petition. After the late withdrawal deadline (or after grades are posted, whichever is sooner), only retroactive withdrawals are considered and verifiable documentation is required. Contact CLAS Advising (NC 1030 – 303-315-7100) for more information on retroactive withdrawals.
May 7 – 12	**Finals Week**
May 12	**End of Semester** **Commencement Ceremony**
May 17	**Final Grades Available** – Official grades available in UCDAccess and transcripts (tentative). Canvas does not display final grades.
June 22	**Degrees Posted** – Degrees posted for graduating students on transcripts.