

St. Francis Xavier University
Department of Computer Science
CSCI 550: Approximation Algorithms
Course Outline
Fall 2021

1 Course Overview

Approximation algorithms are efficient algorithms that are guaranteed to compute solutions such that the value of the solution is provably close to the optimum. This course provides an introduction at the graduate level to the area of approximation algorithms, highlighting key algorithm design techniques for approximation algorithms and the complementary study of hardness of approximation for hard optimization problems.

2 Learning Objectives

By the end of this course, you will be able to:

- Understand the mapping of real-world problems to algorithmic solutions.
- Select and apply advanced algorithmic techniques to solve real problems.
- Select and apply advanced analysis techniques to algorithms.

Objectives from *CS2013: Curriculum Guidelines for Undergraduate Programs in Computer Science*, ACM/IEEE.

3 Instructor

Taylor J. Smith

- Email: tjsmith@stfx.ca
- Office location: Annex, Room 9A
- Student hours: By appointment

Special Note for Fall 2021. In lieu of holding regularly-scheduled office hours, you are welcome to contact the instructor at any time via email to book a virtual meeting. You may also ask questions directly via email, or during our weekly synchronous lecture (see below).

4 Class Time and Location

- Monday, 12:15pm–1:05pm
- Wednesday, 11:15am–12:05pm
- Thursday, 1:15pm–2:05pm

All lectures are held online.

Special Note for Fall 2021. Due to the unique situation of moving this course online instead of holding it in person as originally planned, we will not be scheduling synchronous lectures three times a week. Instead, all course materials will be posted online, and we will hold one weekly synchronous lecture during the Thursday time slot where we will discuss that week's material, work through examples, and so on. As a result, there will be a higher level of self-directedness in this course.

5 Evaluations

Your final grade will be based on the following components:

- Two assignments (20% each, total 40%)
- Student presentation (total 30%): a lesson plan (10%) and the presentation itself (20%)
- Report on the presentation (20%), primarily consisting of curriculum materials and a reflection
- Participation (total 10%): participation on Moodle (5%) and reviewing student presentations (5%)

You must complete both the student presentation and the report on the presentation in order to pass the course. You may not complete one without also completing the other.

Your mid-term grade will be communicated to you by the deadline specified in the university's Academic Regulations. Your mid-term grade will consist of the weighted sum of the grade of your first assignment plus a preliminary participation grade corresponding to your level of participation thus far in the course.

6 Method of Instruction

This course will be delivered online (i.e., all contact between instructor and students is virtual). Course materials will be posted to the instructor's website and to the university's Moodle LMS.

7 Tentative Course Schedule

Week/Date	Topic	Due Dates
Week 1	Introduction to course	
Week 2	Overview/review of computational complexity	
Week 3	Greedy algorithms and local search	
Week 4	Rounding data and dynamic programming	
Week 5	Deterministic rounding of linear programs	Assn. 1 (Oct. 7)
Week 6	Random sampling and randomized rounding of linear programs	
Week 7	Randomized rounding of semidefinite programs	
Week 8	The primal-dual method	
Week 9	Cuts and metrics	Assn. 2 (Nov. 4)
Week 10	Student presentations	
Week 11	Student presentations	
Week 12	Student presentations, course review	Report (Dec. 6)

8 Course Materials and Resources

Course notes will be provided for each lecture. Part I of the course textbook will be used as a supplement and Part II of the textbook will be required for the student presentation component of the course.

Required Text. D. P. Williamson and D. B. Shmoys, *The Design of Approximation Algorithms*. Cambridge University Press, 2011.

A free electronic copy of a pre-publication edition of the textbook is available online at <https://www.designofapproxalgs.com>.

Recommended Text. None.

9 Method of Evaluation

Assignments. This component will give you an opportunity to both demonstrate your understanding of course material and apply your understanding to a variety of problems. Each of the two assignments will consist of questions relating to material covered in the course between the assignment being issued and the

due date. Assignments must be completed individually; however, you are permitted (and encouraged) to collaborate with colleagues in the course, as long as you write solutions on your own.

Student Presentation. This component consists of two submissions: a lesson plan and the presentation itself.

- The lesson plan is a one- to two-page document outlining what you intend to cover in your presentation and how you are going to structure your presentation. The lesson plan will be graded primarily in terms of completeness and relevance.
- The presentation component is designed to give you experience both with studying a topic in this course that most interests you as well as with communicating that topic to others. The presentation itself will be graded primarily in terms of delivery.

The student presentation component will be an individual submission. Further details will be distributed later in the term.

Report. This component is a follow-up to the presentation, where you will submit the materials you created/designed (e.g., presentation slides, notes, activities, etc.) as well as a reflection on your presentation. In contrast to the presentation, the report will be graded primarily in terms of content. The report will be an individual submission. Further details will be distributed later in the term.

Participation. This component is designed to encourage active engagement with the course material. A set of short answer/open response questions will be posted to Moodle each week corresponding to that week's lecture material. By completing the questions each week, you will receive the full 5% for this component. The other 5% is obtained by providing short reviews for each student presentation, which will be distributed to the presenter as peer feedback.

Supplemental Statements for Course Outline

A Statement on Preferred Pronouns

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

See policies at <http://www2.mystfx.ca/equity/policies>.

B Statement on Electronic Devices

During Exams: Unless you have medical accommodations that require you to do so, or explicit permission from the instructor of the course, you may not use any of the following electronic devices during ANY of the tests, midterms, examinations, or other in-class evaluations: cellphones, smart phones, smart watches, smart glasses, audio players or recorders of any sort, video cameras, video games, DVD players, televisions, laptop/notebook/netbook computers, flashlights or laser pointers.

During Lectures and Tutorials: Course instructors may permit the use of a computer during lecture and tutorial periods. If so, you are expected to use the computer for scholastic purposes only, and refrain from engaging in any activities that may distract other students from learning. From time to time, your professor may ask the class to turn off all computers, to facilitate learning or discussion of the material presented in a particular class. Unless explicitly noted otherwise, you may not make audio or video recordings of lectures – nor may you edit, re-use, distribute, or re-broadcast any of the material posted to the course website.

C Copyright

The materials in CSCI 550: Approximation Algorithms at StFX are the property of the instructor, unless stated otherwise by the instructor. Online posting or selling this material to third parties for distribution without permission is subject to Canadian Copyright law and is strictly prohibited.

Please visit the StFX copyright guide for more information: http://sites.stfx.ca/library/campus_copyright.

D Policy on Academic Integrity

Please ensure that you are aware of the policy on Academic Integrity. Details can be found at: http://www.sites.stfx.ca/registrars_office/academic_integrity. Please make note of the change in wording of the section on 'Cheating' passed by Senate this year. Section 3.8.2b (v) now reads "Possession of unauthorized aids or assistance". This means that the students do not need to be caught USING a device like a cell phone or smart watch (for example) during a test or exam to be in violation of the policy. Simply having the unauthorized device on your person during the test or exam is a violation of the policy.

E Statement on Equitable Learning

Everyone learns more effectively in a respectful, safe and equitable learning environment, free from discrimination and harassment. Instructors and students are invited to work together to create a classroom space – both real and virtual – that fosters and promotes values of human dignity, equity, non-discrimination, and respect for diversity. Please feel free to talk with your course instructor about your questions or concerns about equity in our classroom or in the StFX community in general.

Should students have additional questions, they are encouraged to talk to the Chair/Coordinator of the Department/Program or the Human Rights and Equity Advisor. Contact information can be found at <https://www2.mystfx.ca/equity/staff>.

F Information about Requesting an Accommodation at StFX

If you have a different learning ability and would like to request accommodations, please contact the instructor during the first week of the semester so that your accommodations may be provided in a timely manner. Centre for Accessible Learning (CAL) provides assistance in determining and facilitating appropriate accommodations for students with verified disabilities.

The Tramble Center for Accessible Learning welcomes students with documented permanent disabilities and offers them a student-centered program of support. Located in Room 108 of the Angus L. MacDonald Library, new and returning students meet with program staff to discuss options for support. Deadline for registering with the Center is two weeks prior to the end of classes each semester and three business days notice is required for booking all accommodated tests and exams.

To book an appointment, please use the following link: stfxcal.mywconline.com.

Phone: (902) 867-5349

Email: tramble@stfx.ca

G Support Services

There are various support services around campus and these include, but are not limited to:

1. Student Life: <https://www.stfx.ca/student-life>
2. Office of the Registrar: <https://www2.mystfx.ca/registrars-office/>
3. Health & Counselling Centre: <https://www.stfx.ca/student-life/health-and-wellness>
4. Academic Advising: <https://www2.mystfx.ca/academic-advising/>
5. Student Success Centre: <https://www2.mystfx.ca/student-success/>
6. Student Career Centre: <https://www2.mystfx.ca/scc/>
7. Office of Internationalization: <https://www.stfx.ca/international/support-international-students>
8. Financial Aid Office: <https://www2.mystfx.ca/financial-aid/>

H Health and Wellness

As part of a successful undergraduate experience at St. Francis Xavier University, we encourage you to make your health and wellness a priority. StFX provides several on-campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your degree. For example, to support physical activity, all students receive membership to the StFX Athletics & Recreation Centre as part of their registration fees. Please visit the Athletics & Recreation website (<https://www.stfx.ca/student-life/athletics-and-recreation>) for opportunities including intramural sports. Numerous cultural events are offered throughout the year. Please check out the Department of Music web page (<https://www2.mystfx.ca/music/visiting-artist-program>), the StFX Art Gallery (<https://www2.mystfx.ca/art-gallery/>) or Theatre Antigonish (<https://www.theatrens.ca/producers?c=theatre-antigonish>) for various events.

Further information regarding health and wellness-related services available to students may be found at <https://www.stfx.ca/student-life/health-and-wellness>. If you are in emotional or mental distress please refer to the various mental health supports provided through Health & Counselling at <https://www2.mystfx.ca/health-and-counselling/>.