DALHOUSIE UNIVERSITY

Faculty of Computer Science

CSCI-6905 — Compact Data Structures in Computational Genomics
Course Syllabus

Instructor Information

Instructor:	Travis Gagie
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Class Meeting Time:	Mon. 10:35–11:55, Thurs. 16:05–17:25
Course Homepage:	`https://web.cs.dal.ca/~gagie/6905.html`

Important Dates

1. First class: January 7th
2. CGEM seminar (optional but encouraged): January 13th
3. Assignment 1 due: January 24th (5%)
4. Assignment 2 due: January 31st (5%)
5. Winter Study Break: February 15th–19th
6. Video presentation due: February 21st (20%)
7. One-on-one meeting about experiment: by March 21st (30%)
8. Main report: April 4th (20%)
9. Last class: April 8th
10. Mini report: 1 week before grades due (date TBA)

The policies about withdrawals have been changing so I'll check with FCS about the deadlines.

Course Description

This course will cover the use of compact data structures in computational genomics and pan-genomics, focusing on DNA read alignment against single reference genomes, collections of reference genomes, variation graphs, etc. Students are expected to experiment with and compare two implementations of pan-genomic indexes.

Learning Outcomes

- Explain the problems with using a single reference sequence.
- Compare alternatives for pan-genomic read alignment.
- Install, use and evaluate those alternatives.
- Present their findings and discuss possible improvements.

Class Format and Course Communication

- Students are expected to watch 2 hours of videos or read a paper each week, and participate in online discussions, which will be held on Teams or Webex.
- Announcements will be posted on the course webpage.

Evaluation Criteria

1. Assignments (30%)

    - Two assignments (5% each).
    - **Late assignments will not be accepted.**
    - Assignments must be submitted by email.

2. Video presentation due: February 21st (20%)
3. One-on-one meeting about experiment: by March 21st (30%)
4. Main report: April 4th (20%)
5. Last class: April 8th
6. Mini report: 1 week before grades due (date TBA)
7. Video presentation (20%).

    - Link to be submitted by email.

8. One-on-one meeting describing results of comparison (30%).

    - The student chooses the implementations to be compared.
    - The mark is primarily for the experiment, only secondarily for the meeting.
    - Will cover all material in the course.

9. Main report (20%).

    - The main report should be 10 to 20 pages long and fit to be given to colleague as a summary of research.

10. Mini report (10%).

    - The mini report should put the main results of the the main results of the student's main report into the context of the main results of the other students' main reports.

This is an advanced graduate course and a commensurate effort is expected. You are responsible for performing a thorough and incisive experimental investigation.

Tentative Schedule of Topics

1. Weeks 1–3 (Jan 6–24)

    - course "Algorithms for DNA Sequencing"
    - course "Indexing"

2. Weeks 4–5 (Jan 25–Feb 7)

    - advantages of personalized medicine
    - "fixing" the reference genome
    - using different references for different groups
    - difficulties scaling Bowtie and BWA

3. Weeks 6–8 (Feb 8–28)

    - founder sequences
    - PanVC
    - RLCSA, r-index, MONI/PHONI

4. Weeks 9–10 (Mar 1–14)

    - minigraph
    - vg, Giraffe
    - PLAST

Responsible Computing Policy

Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies (`http://its.dal.ca/policies/`) and the Faculty of Computer Science Responsible Computing Policy. (`https://www.cs.dal.ca/downloads/fcs_policy_local.pdf`)

Use of Plagiarism Detection Software

All submitted code may be passed through a plagiarism detection software, such as the plagiarism detector embedded in Codio, the Moss Software Similarity Detection System (`https://theory.stanford.edu/~aiken/moss/`), or similar systems. If a student does not wish to have their assignments passed through plagiarism detection software, they should contact the instructor for an alternative. Please note, that code not passed through plagiarism detection software will necessarily receive closer scrutiny. `https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf`

Copyright Notice

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Culture of Respect

Every person has a right to respect and safety. We believe inclusiveness is fundamental to education and learning. Misogyny and other disrespectful behaviour in our classrooms, on our campus, on social media, and in our community is unacceptable. As a community, we must stand for equality and hold ourselves to a higher standard.

What we all need to do [1]:

1. **Be Ready to Act:** This starts with promising yourself to speak up to help prevent it from happening again. Whatever it takes, summon your courage to address the issue. Try to approach the issue with open-ended questions like "Why did you say that?" or "How did you develop that belief?"
2. **Identify the Behaviour:** Use reflective listening and avoid labeling, name-calling, or assigning blame to the person. Focus the conversation on the behaviour, not on the person. For example, "The comment you just made sounded racist, is that what you intended?" is a better approach than "You're a racist if you make comments like that."
3. **Appeal to Principles:** This can work well if the person is known to you, like a friend, sibling, or co-worker. For example, "I have always thought of you as a fair-minded person, so it shocks me when I hear you say something like that."
4. **Set Limits:** You cannot control another person's actions, but you can control what happens in your space. Do not be afraid to ask someone "Please do not tell racist jokes in my presence anymore" or state "This classroom is not a place where I allow homophobia to occur." After you have set that expectation, make sure you consistently maintain it.
5. **Find or be an Ally:** Seek out like-minded people that support your views, and help support others in their challenges. Leading by example can be a powerful way to inspire others to do the same.
6. **Be Vigilant:** Change can happen slowly, but do not let this deter you. Stay prepared, keep speaking up, and do not let yourself be silenced.

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[1]Source: Speak Up! ©2005 Southern Poverty Law Center. First Printing. This publication was produced by Teaching Tolerance, a project of the Southern Poverty Law Center. Full "Speak Up" document found at: `http://www.dal.ca/dept/dalrespect.html` Revised by Susan Holmes from a document provided April 2015 by Lyndsay Anderson, Manager, Student Dispute Resolution, Dalhousie University 902.494.4140 `lyndsay.anderson@dal.ca` `www.dal.ca/think`.

University Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate.
`https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=69&chapterid=3457&loaduseredits=False`

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.
`http://www.dal.ca/dept/university_secretariat/academic-integrity.html`

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of: a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (NS, NB, PEI, NFLD).
`http://www.dal.ca/campus_life/student_services/academic-support/accessibility.html`

Student Absence Declaration

In January 2018, the Student Declaration of Absence Form was introduced in select courses to re-place sick notes for absences of three days or fewer that result in missed or late academic require-ments.
`https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html`

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.
`https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-life-policies/code-of-student-conduct.html`

Diversity and Inclusion —- Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2).
`http://www.dal.ca/cultureofrespect.html`

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the McCain Building (room 3037) or contact the programs at `elders@dal.ca` or 902-494-6803 (leave a message).

Learning and Support Resources

General Academic Support — Advising `http://www.dal.ca/campus_life/student_services/academic-support/advising.html`

Fair Dealing Guidelines `https://libraries.dal.ca/services/copyright-office/guidelines/fair-dealing-guidelines.html`

Dalhousie University Library `http://libraries.dal.ca`