BIO722 - Genomic Analysis

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Outline for today

- Introductions around the class
- What to expect in this class
- Course outline
- Course projects and evaluation
- Discussion: Why do we use genomics? What is good for? What are its limitations?

What to expect in this class

- This class is very much what you make of it.
- While we will be running lectures and tutorials for the first half of the class, it is mostly independent and small group project work.
- Genomic analysis needs to be learned through actively doing it, discussing the work, and refining your thinking and analyses.

Semester overview

- Introduction to differential gene expression analysis using RNAseq (and fundamentals of genomic analysis). ~3 weeks.
- Syntenic mapping of sequence reads to transcriptomes and genomes
- Counting and analysis of mapped reads
- Differential Gene Expression analysis of RNAseq data
- Quality assessment at multiple stages of analysis
- Project pitches by students (first week of February)
- Brian (TBD) - Likely some advanced UNIX tools to make large scale analyses run smoothly (2 weeks)
- Ben Evans - Population Genomics, variant calling, GWAS (TBD)
- The rest of the semester will be group workshop/tutorials presented to the class.

Course evaluation breakdown

Project Proposal: 10% - First week of February - Written (2 pages maximum) - Class pitch (10 minutes + 5 minutes questions)

Group Project: 30% - workshop/tutorial led by small groups (2-3 people) - Throughout March

Progress report for independent project: 5% - Early March - Written, 1-2 pages - We may do a short in class oral update

Final Project: 45% - Due mid-late April - Written paper and annotated and reproducible code (github)

Class Participation: 10%

Possible topics for group workshops/tutorials

- Transcriptome Assembly
- Differential transcript (or exon level) analyses (DTE, DTU, etc)
- meta-genomics
- DNA methylation (analysis of bisulfite sequencing)
- Chromatin accessibility (ATACseq, DNAse1seq, FAIRE, etc)
- Differential co-expression analysis
- How to combine multiple genomic analyses together (multi-omics)
- Genome annotation
- Gene Ontology analyses

Why genomics

- Before we spend the rest of the semester just "doing it" with respect to genomic analysis, let's spend a bit of time on
- **Why** do we do genomics?
- **What** can (in an optimal world), genomic studies tell us?
- What is it (in a real world) likely to be able to tell us?
- What can't genomics tell us?
- Are genomic analyses hypothesis generating? Testing? Both? Neither?
- **How** to (not) lie with genomics.