Differential gene expression analysis workshop

Owen M. Wilkins, PhD

Bioinformatics scientist

Center for Quantitative Biology, Geisel School of Medicine at Dartmouth

Email: DataAnalyticsCore@groups.dartmouth.edu

Website: (https://sites.dartmouth.edu/cqb/projects-and-cores/data-analytics-core/

07/18/22

Center for Quantitative Biology at Dartmouth

Mission: Support and enhance quantitative biological research at Dartmouth and to facilitate its integration with experimental biology

Activities:

- Invest in instruments and infrastructure
- Improved sample management
- Support for new method development
- Pilot grants for new users or novel projects
- Dedicated data analysis resources

Cores:

- **Single cell genomics Core**
- **Data Analytics Core**

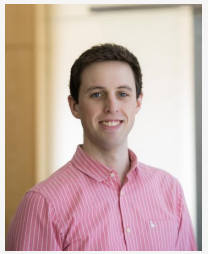
Website: *https://sites.dartmouth.edu/cqb/*

The Data Analytics Core

CQB Center for Quantitative Biology

Personnel:

James O'Malley, PhD
Faculty Director



Owen Wilkins, PhD
Bioinformatics Research Scientist

Shannon Soucy, PhD
Senior Research Scientist

Tim Sullivan, BA
Bioinformatics Research Scientist

What we do:

Genomic & bioinformatic data analysis to the CQB & Dartmouth research community

Services:

Genomic Data Analysis

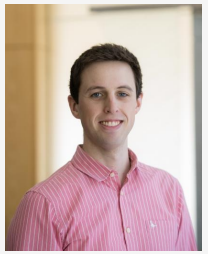
Publication & grant support

Bioinformatics training (workshops)

The Data Analytics Core

Personnel:

James O'Malley, PhD
Faculty Director



Owen Wilkins, PhD
Bioinformatics Research Scientist

Shannon Soucy, PhD
Senior Research Scientist

Tim Sullivan, BA
Bioinformatics Research Scientist

Main data analysis services:

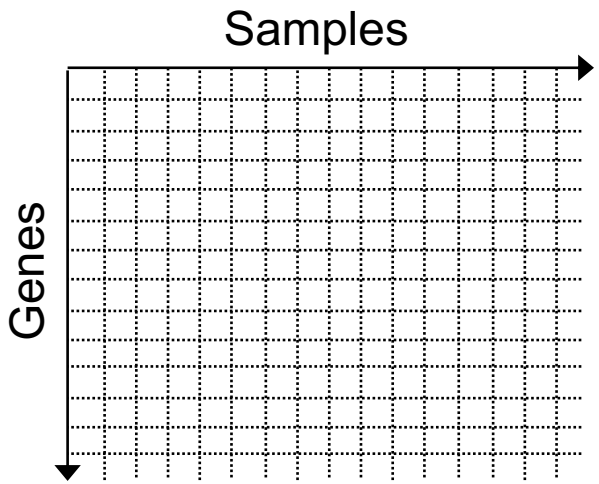
- RNA-seq (bulk)
- Epigenetics (ATAC-seq, ChIP-seq, DNAm)
- Phylogenetics
- Comparative genomics
- Single cell genomics
- Variant analysis (WGS/WES)
- Other

Goals of the workshop

- Understand the basic principles of a differential expression analysis using RNA-seq data
- Develop a working understanding of the fundamental statistics behind a typical differential expression analysis using R/Bioconductor packages
- Perform a differential expression analysis using R/Bioconductor packages
- Learn how to explore the results and make robust insights from your data

Workshop outline

Gene expression matrix
(read counts)



+

Sample metadata

Normalization

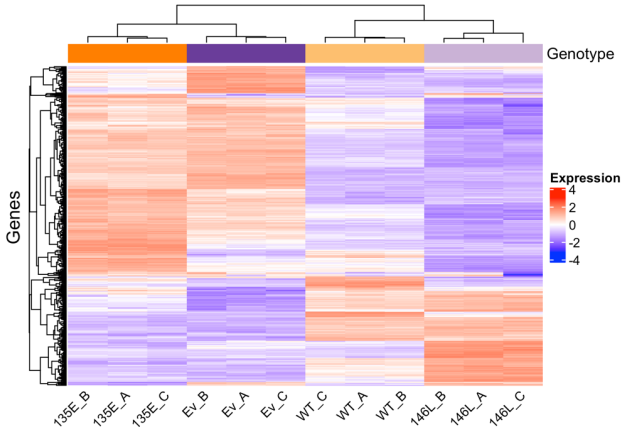
Exploratory analysis

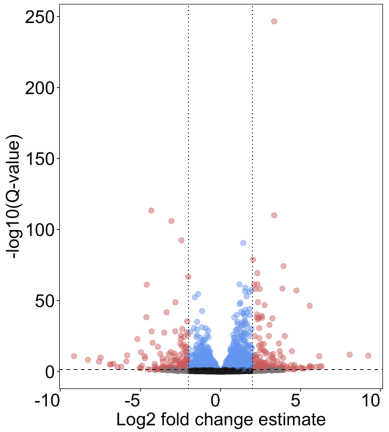
Statistical modeling

Visualization

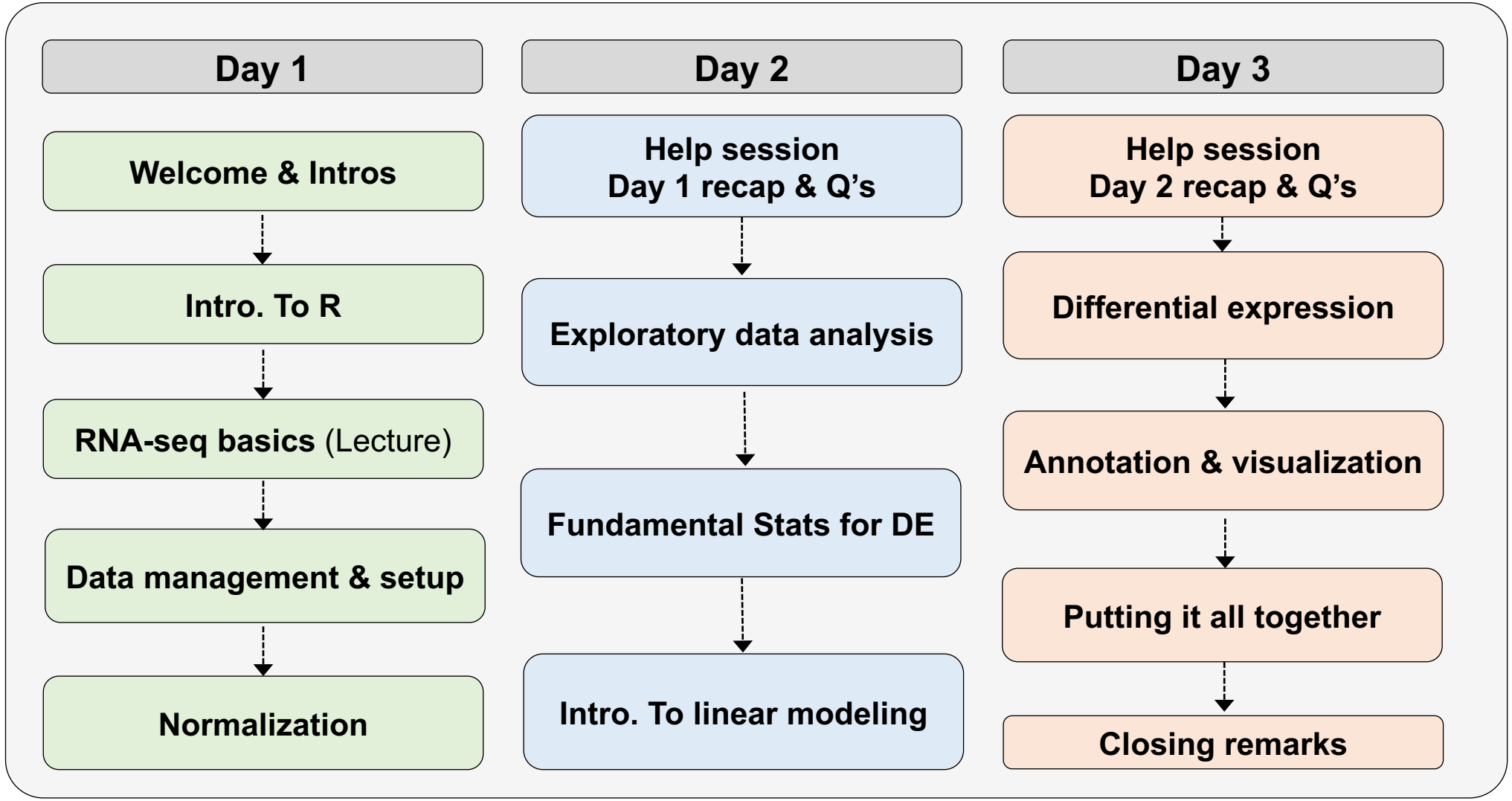
Differential expression results

ID	lfc	lfcSE	stat	pvalue	padj	Gene
ENSG032219	2.89	0.12	-25.4	1.6E-251	1.7E-249	ARID4A
ENSG012951	-3.44	0.15	-24.5	1.2E-132	1.4E-122	KLK10
ENSG016754	-3.14	0.12	-24.1	2.9E-123	1.4E-118	KLK5
ENSG080097	-2.78	0.11	-20.7	5.7E-115	2.4E-109	LGALS1
ENSG006277	5.92	0.28	19.8	1.9E-80	3.5E-92	UCHL1
…..	…..	…..	…..	…..	…..	…..





Workshop outline



Schedule

- Can be found at: https://github.com/Dartmouth-Data-Analytics-Core/RNA-seq-Differential-Expression-workshop-June-2021/blob/master/schedule.md
- 12pm-5pm each day
- Schedule is best guess, and we may deviate from it based on time
- If you will be absent for a session, just let us know

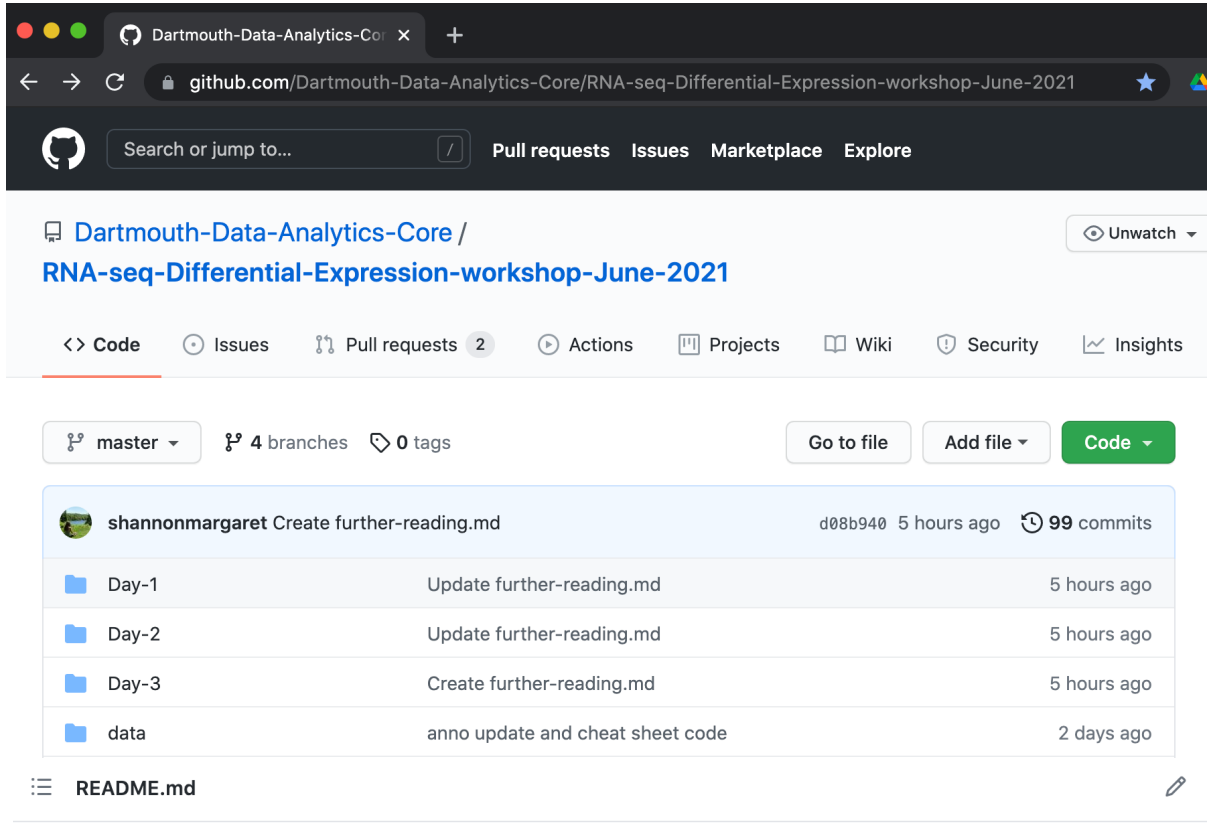
Logistics I

- Course materials are all online (and will stay there):

  https://github.com/Dartmouth-Data-Analytics-Core/RNA-seq-Differential-Expression-workshop-June-2022

- You will download the materials on your local machine during the workshop

- We will be copying R code from markdowns (.md) into the RStudio



RNA-seq differential expresssion workshop, August 2021

This workshop will be delivered on August 23, 25, & 27 by the Data Analytics Core (DAC) of the Center for Quantitative Biology at Dartmouth.

The DAC aims to facilitate advanced bioinformatic, computational, and statistical analysis of complex genomics data for the Dartmouth research community.

If you have questions about this workshop, or would like to discuss data analysis services available from the Data Analytics Core, please visit out website, or email us at: DataAnalyticsCore@groups.dartmouth.edu

CQB Center for Quantitative Biology

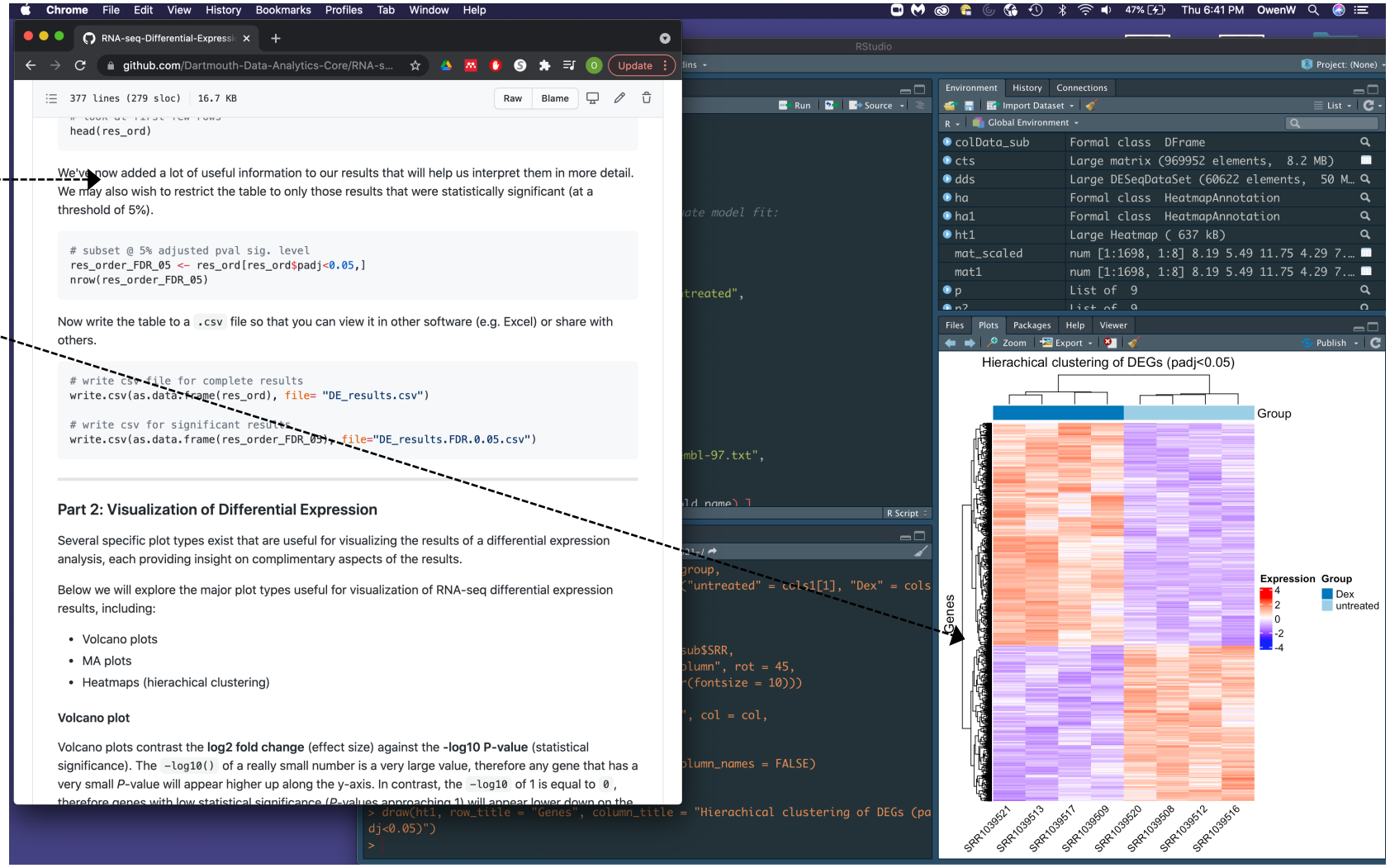
Logistics II

- Multiple tabs open:
  - Web browser
  - RStudio

- Copy & paste code from Markdowns to Rstudio

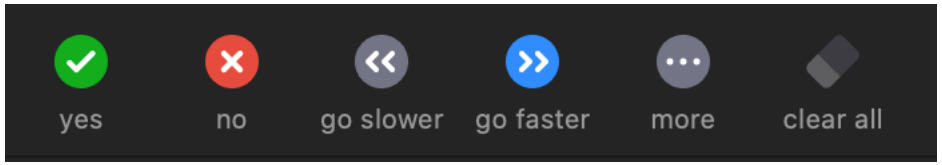
- If you finish: edit the code, try different options, generate scripts

- Use the ***cheat sheets for R!***

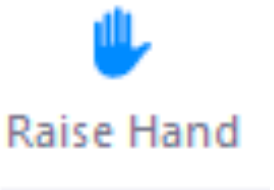


Logistics III

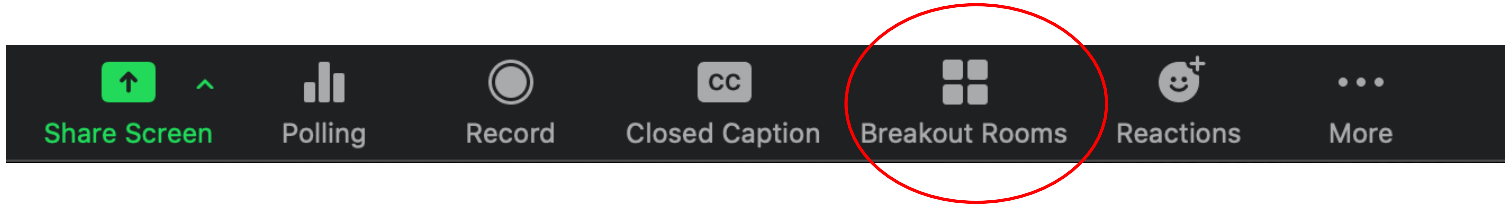
- Use buttons in *Participants* tab in zoom



- You'll be muted, but if you want to ask a question, just raise your hand

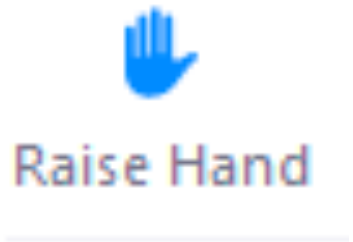


- We'll be using *breakout rooms (BRs)*
  - We will use these when we split up to run code independently
  - We've tried to pair everyone based on experience
  - If your stuck, message us, and we will come help you in your (BR)
  - When we are going to move on, breakout rooms will close



- Please be courteous on zoom..

How to get help?



- **Raise your hand in zoom** (bottom right, participants tab)

- **Use the slack channel to message one of us**
  - Use the ***general*** channel if it might benefit everyone
  - Message us directly if its specific

- **If all else fails, email us:**
  - DAC: DataAnalyticsCore@groups.dartmouth.edu
  - Shannon Soucy (Shannon.Margaret.Soucy@Dartmouth.edu)
  - Tim Sullivan (Timothy.J.Sullivan@dartmouth.edu)
  - Owen Wilkins (omw@Dartmouth.edu)

Questions after the workshop?

Bioinformatics office hours

Friday 1-2pm (every other week, check calendar):

https://sites.dartmouth.edu/cqb/upcoming-events/calendar/

Zoom link: https://dartmouth.zoom.us/s/96998379866

Passcode: bioinfo

- At the end, please give us feedback about this workshop, there will be a survey!

- And please ask lots of questions!

Questions?

Please remember to introduce yourself on the slack channel

Name, department/program, research interests, why are you taking the workshop?