Program Background, Student Expectations & HPCBio Projects

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PROGRAM OVERVIEW
R25 Partnership

**Quick summary:**

- Partnership that aims to provide external Bioinformatics education opportunities to Fisk students and faculty

- Partnership is between:
  - Fisk University
  - University of Illinois at Urbana-Champaign (UIUC)
  - BD2K/KnowEnG
R25 Program

What does this mean for you?

• Remote access to UIUC Bioinformatics seminars
  – That was this past Spring

• Summer research experiences
  – Potentially for two consecutive Summers
    • More on that later...
So many groups!

- Fisk University
- University of Illinois at Urbana - Champaign
  - BD2K
    - KnowEnG
  - HPCBio
  - SROP
- Let’s take this one group at a time...
BD2K = Big Data 2 Knowledge

– Program that aims to “facilitate broad use of biomedical big data, develop and disseminate analysis methods and software, enhance training relevant for large-scale data analysis, and establish centers of excellence for biomedical big data”

– They are funding this Summer program. Yay money!
HPCBio

HPCBio = High Performance Computing in Biology

• A consulting group at UIUC that provides Bioinformatics analyses and workshops for researchers and students

• You will be working one-on-one with us most of the Summer
SROP

SROP = Summer Research Opportunities Program

- “Provides undergraduate students from populations underrepresented in graduate study with an opportunity to explore careers in research”
- 9 week program
  - Conduct research project in a real lab
  - Attend professional development seminars
  - Attend research team meetings and research writing sessions
  - Attend social events

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Assoc. Director of Educational Equity Programs

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SROP

• You’ll be housed in the same building as the other SROP students
• You’ll be able to participate in most activities for 5 weeks
  – If you come back to UIUC next year (2019), you’ll be fully immersed in SROP and assigned a faculty advisor

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R25 SUMMER RESEARCH EXPERIENCE
General Expectations

1. Be at HPCBio every weekday for research
   - Hours may vary from week to week
   - Building: Institute for Genomic Biology
   - Our offices: 2000 or 2112

2. Attend SROP activities
   - Seminars, research team meetings, research writing, social activities

3. Create PP Presentation of research project by end of June
   - Will create figures throughout month
   - Last week will put it all together

5. Respond to emails promptly

6. Complete any homework by due dates
Learning Expectations

1. Creating reproducible research
   – Project organization on Linux machine
   – Keep a Bioinformatics lab notebook

2. Using a computational cluster
   – IGB’s Biocluster

3. Understanding of RNA-Seq
   – Its purpose and applications
   – Basic analysis steps

4. Presenting scientific research
   – PowerPoint presentation
Detailed Timeline

- **Week 1**
  - Get acquainted with campus and HPCBio
  - Learn bioinformatics basics
  - Visit a sequencing center to see where data comes from
  - Meet with labs that generated RNA-Seq datasets

- **Week 2**
  - Learn about what an RNA-Seq analysis is
  - Choose RNA-Seq project
  - Perform RNA-Seq pre-processing steps

- **Week 3**
  - Finish up pre-processing
  - Learn basics of R
  - Perform statistical analysis on RNA-Seq data
Detailed Timeline

• **Week 4**
  – Finish up statistical analysis
  – (optional) learn an additional skill
    • Transcriptome assembly or alternative RNA-Seq pipeline

• **Week 5**
  – Summarize projects and a PowerPoint presentation
  – Present PowerPoint during HPCBio group meeting

• **3 weeks of research at Fisk University**
  – Can continue to use Biocluster for this
  – RNA-Seq project
    • This is what you’ll write your research proposal on for the SROP research writing
RNA-SEQ ANALYSIS
Definition

**RNA sequencing (RNA-Seq):**
Using next-generation sequencing to determine the presence and quantity of RNA in an organism at any given moment.
Applications of RNA-Seq analysis

1. To assemble a transcriptome
   - What genes & transcripts exist?
   - What is their structure?

2. To find out what an organism’s genes doing under certain conditions
   - What genes are being expressed?
   - Are the gene expression levels different under varying conditions?
   - Is this significant (or likely true)?
LAST YEAR’S RNA-SEQ PROJECTS
RNA-Seq Dataset 1
Human

- 9 samples
- 3 conditions
  - Irrelevant siRNAs
  - Mov10 knock down
  - Mov10 over expression
- 3 replicates each

- How does the gene silencing Mov10 gene affect the expression of other genes in humans?
RNA-Seq Dataset 2
Mouse fire fighting study

- 70 samples
- 3 treatments
  - Control, left in lab
  - No smoke, went to location but not exposed
  - Smoke, went to location & exposed to fire after extinguished
- 2 fire-fighting scenarios
  - Outside-in fires
  - Inside-out fires
- 11-12 reps of each condition/technique

How do different smoke conditions and fire-fighting scenarios affect our gene expression?
RNA-Seq Dataset 3
Infected Mice

• 24 samples
• 3 conditions
  • Control (0 days)
  • 4-day post-infection
  • 8-day post-infection
• 2 tissues
  • Spinal cord
  • Cerebellum
• 2 sexes
• 4 reps of each condition/tissue

• What genes are affected by infection? Specifically in the nervous system tissues: brain & spinal cord
RNA-Seq Dataset 4
Honeybee behavior

- 48 samples
- 2 times
  - Morning, when inactive
  - Afternoon, before leaving to forage or seek mates
- 2 sexes/behaviors
  - drones (male) - seek mates or queen bees
  - workers (female) - forage for nectar & pollen
- 12 reps of each time/sex

What genes are active during the anticipation of a reward-seeking flight in response to learned/trained or instinctive behaviors?
GETTING AROUND CAMPUS
UIUC Campus

• Our campus is situated in two towns
  – Champaign & Urbana (pop. ~239,000)

• Huge campus
  – 353 main campus buildings (647 total)
  – Don’t worry, we’ll help you navigate 😊

• Well known for research & development in science and engineering
  – Including Bioinformatics!
MTD System

• Serves campus and much of Champaign & Urbana
• Many ways to determine bus schedule...
  – Website: https://mtd.org/
    • Trip planner
    • Maps
    • Bus stops
  – Phone app: Illini Bus
  – Paper schedule (can find them on buses)
  – Bus kiosks
  – Bus-stop signs
Walking

• Bring an umbrella!
  – Weather has unpredictable lately

• Use your maps
  – Paper handout
  – Interactive map: https://map.illinois.edu/view

• Campus is generally safe, but always be vigilant, especially at night
FINAL THOUGHTS
Questions for you

• What day/time will you leave?
• Do you need to borrow a laptop?
Questions?

• What concerns do you have?
• Is there anything I didn’t cover?