Introduction

- Design and deliver an introductory Bioinformatics and Computational Biology (BCBio) undergraduate course at Iowa State University (ISU) with a Modified Moore Method (M^3)
- Small class (<20 students)
- Students from mostly biological backgrounds
- Instructors with both computational and biological experiences
- M^3 has been used almost entirely for teaching mathematics in the past and is an approach towards inquiry-based learning (IBL)

Course Content

- Introduction to bioinformatics
  - Genomics Subject Matter
  - Genome Sequencing & Assembly
  - Structural & Functional Annotation
  - Comparative Genomics
- Development of practical skills
  - Basic Programming and Scripting
  - Data Discovery
  - Data Management
  - Data Transmogrification
  - General Problem Solving

Ultimately…

- Avoid this…

Modified Moore Method

- Treat a pair of students as a single unit
- Students will turn in exercise solutions prior to attending class
- Students will receive a point for showing up, but will only earn additional points for presenting
- Grade based on:
  - Exercises (75 points)
  - Midterm (30 points) and Final (30 points) Exams
  - Final Presentation (30 points)
  - Attendance (10 points)
Modified Moore Method (cont.)

- IBL – Inquiry Based Learning
  - Teaching through solving questions
  - “Flipped Classroom” – students lead the course through presentation of solutions
  - “Moore Method” – first used by R.L. Moore when teaching math courses at UT Austin
- Bottom Line – No lectures; instructors provide questions in advance and guide students during class

Sample Exercise Question:
Assuming the above transition matrix, what is the probability of reaching node c starting from node b in exactly 100 steps?

Example Homework

7. If the current nucleotide in the sequence is A, what will be the next nucleotide? Let the probability be $p_{AC}$. Develop a transition matrix for this. What is the probability of transitioning from A to C?

8. If the current nucleotide in the sequence is a random nucleotide, what will be the next nucleotide? Let the probability be $p_{AC}$ for A to C, $p_{AG}$ for A to G, $p_{AT}$ for A to T, $p_{CG}$ for C to G, $p_{CT}$ for C to T, and $p_{GT}$ for G to T. Write the transition matrix for this. What is the probability of transitioning from A to C, given that the current nucleotide is a random nucleotide?

9. What is the probability of reaching node c starting from node b in exactly 100 steps? (I do not know how to answer this.)

Results

- Student Survey Data

  - Data Discovery: 100%
  - Data Management: 100%
  - Data Transmogrification: 100%
  - Genomics Subject Matter: 100%

Lessons Learned

- Student pairing was not a good idea since there was no diversity in background
- Successful teaching programming to biological students with minimal programming background
  - Course format enabled more engagement to material and more creative solutions
  - Textbook: Practical Programming for Biologists
- Some students prefer the course to be reordered:
  - Current order: Programming -> Application
  - New order: Programming taught as application occurs

- Common issues with an IBL courses: What to do when student gets stuck on the board?
  - Break down into smaller questions
  - Pause & return
  - Whole class solve together
- Benefits of IBL courses
  - Closing the gap (both gender and race)
  - Interactions reduces prejudices from both instructor and students (self and peer)
  - Deeper mastery of material
Final Thoughts

- Beware of “MOOC”
  - Massive
  - Open
  - Online
  - Courses
- “Strategic Liability”
- “Professional Misconduct”

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