ANSC 542 CPSC 569 IB 506
APPLIED BIOINFORMATICS

Credit: 4 hours

Instructors:

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Course name: ANSC 542 / CPSC 569 / IB 506 Applied Bioinformatics
Course web page: https://compass2g.illinois.edu/
Compass web page login and password: Netid and associated password, respectively.

Course Information
Meet days, times and place are indicated in the course webpage (IGB 607 or LIAC computer lab)
Office hours: by appointment.
On-line support: day and times are indicated in the course webpage
Students are encouraged to review the course webpage daily for updates on course support information. Particularly useful links are: Assignments, Calendar, Announcements, and class notes.

Prerequisites: Graduate or undergraduate status and basic knowledge on molecular biology.

Reading requirements: Class notes.

Learning objectives: Genomic and proteomic projects generate large amounts of complex data that challenge the effective storage, analysis and interpretation of biological information. The goal of this course is to introduce students to a range of bioinformatics topics, integrating concepts in biology, statistics, computer and information sciences. The course combines lecture materials and hands-on experiences that facilitate the students' understanding of concepts and a wide range of commonly used databases and tools.

The students will be introduced to a variety of bioinformatic databases and tools and will apply the concepts to individual projects related to their own research or interest. Applied Bioinformatics includes hands on exercises in databases, sequence alignment, next-generation sequence analysis, phylogenetic analysis, statistical analysis using R, biomolecular folding, biological networks and the use of web resources in bioinformatics. Classes include concepts and demonstrations. At the end of the course the student will understand how to effectively use important bioinformatic resources available.

Outline of topics (by instructor alphabetic order)

Instructor: Dr. Caetano-Anollés

1. Introduction: Patterns, processes, and science in bioinformatics. Genes in genomes and populations. Trees and genomic archaeology
2. Patterns in molecular evolution: Inferring molecular phylogeny. Phylogeny and Bayesian inference. Processes in molecular evolution: Evolutionary models
3. Comparative genomics and phylogenomics
4. Cladistics and molecular evolution. Experimental focus: Phylogenetic reconstruction with PAUP*
5. Molecules and structure: Patterns and form in RNA. RNA folding, evolutionary processes, and the history of our natural world. Experimental focus: RNA folding.
6. Molecules and structure: Patterns and form in protein structure. Structural diversity in proteins. Protein domains and evolution.

Instructor: Dr. Rodriguez Zas

1. Introduction to bioinformatics, Biology Workbench and Galaxy.
2. PAM and BLOSUM scoring schemes
3. BLAST
4. Statistics of alignments and multiple sequence alignment.
5. Conserved patterns and profiles.

Instructor: Dr. Villamil

1. Introduction to R
2. Applications of R to statistical analysis
3. Applications of R to statistical analysis
4. Applications of R to bioinformatics.

Grading

Grading will be based on 5 assignments. Each assignment has a value of 200 points and all assignments total 1000 points. The grade scale is A > 900, A- > 850, B+ > 800, B >750, B- > 700, C+ >650, C > 600, C- > 550, D > 500, F < 500. The total points-to-grade scale will be based on the total final cumulative score of all the assignments.

Deadlines: All homework assignments are posted in the course webpage within the Assignment link. The assignment links include the assignment deadlines. No extensions beyond the posted deadline are possible.

Homework assignments will be released during the semester. Questions about particular assignment questions must be directed to the responsible instructor indicated in the assignment. Questions can be initiated via email to the instructor. Students are encouraged to review the assignments as soon as they become available and submit questions on advance of the deadline. Some assignments require the use of internet and public bioinformatics resources. Students are encouraged to start these assignments promptly because internet speed and resource access may vary.

Assignment	Points	Responsible instructor
Patterns in evolution	200	Caetano-Anollés
Structure	200	Caetano-Anollés
Sequences and alignments	200	Rodriguez Zas
Alignments and conserved profiles	200	Rodriguez Zas
R	200	Villamil

Basic outline of assignments: The assignments consist of one or two components. One component includes general questions and exercises based on the class materials including lecture notes and labs. The second component includes the application of the class materials to real life scenarios.

Homework handouts that describe the assignment and steps required for its completion will be available for download from the Assignment link in the course *Compass2g* webpage. Assignments will encourage problem solving and the answers submitted by the students must be legibly written and express the findings and opinion of each student.

Assignment submission: All assignments must be electronically submitted using the course *Compass2g* webpage. Electronic mail attachments or printed assignment submissions will not be accepted. Only one file will be accepted per homework assignment and student. The assignment file must be named with the *netid* (or last name) of the student followed by the homework assignment number (e.g. rodrgzzs_hwk3, gca_hwk1, or villamil_hwk5).

IMPORTANT: Students are responsible of ensuring that their work is correctly and successfully submitted electronically and should notify the instructor of any problems with the internet connection or website at least 10 minutes before the assignment deadline. Students are encouraged to submit their assignments at least 20 minutes before the deadline.

Recommended reading

Higgs PG, Attwood TK (2005) Bioinformatics and molecular evolution. Blackwell Publishing.

Suggested readings

Caetano-Anollés G (2010) Evolutionary genomics and systems biology. Wiley
Gibas C, Jambeck P (2001) Developing bioinformatics computer skills. O'Reilly.
Li W-H (1997) Molecular evolution. Sinauer Associates.

Waterman MS (1996) Introduction to computational biology: Maps, sequences and genomes. Chapman & Hall.
Bishop MJ (1999) Genetics Databases. Academic Press.
Setubal J, Meidanis J (1997) Introduction to computational molecular biology. PWS Pub.
Baxevanis AD, Ouellette BFF (1998) Bioinformatics. A practical guide to the analysis of genes and proteins. John Wiley & Sons.
Weir BS (1996) Genetic data analysis II: methods for discrete population genetic data. Sinauer.
Page RDM, Holmes EC (1998) Molecular evolution:a phylogenetic approach. Blackwell Sci.
Baldi P, Brunak S, Brunak S (2001) Bioinformatics. MIT Press.
Campbell AM, Heyer LJ (2002) Discovering genomics, proteomics, and bioinformatics. Pearson Educ.
Ewens WJ, Grant GR and Grant G (2001) Statistical methods in bioinformatics: an introduction. Springer-Verlag.
Mount DW, Mount D (2002) Bioinformatics: sequence and genome analysis. Cold Sping Harbor.
Krane DE, Raymer ML (2002) Fundamental concepts of bioinformatics. Pearson Educ.

Claverie J, Notredame C (2003) Bioinformatics for Dummies. John Wiley & Sons.

Academic Integrity

The Code on Campus Affairs and Handbook of Policies and Regulations Applying to All Students (available at http://admin.illinois.edu/policy/code/) gives complete details on the students' rights and responsibilities. Students are responsible for knowing and abiding by these rules.

Policies on computer resources and copyrights

All students must adhere to the rules and policies indicated by the software, websites and computer laboratories used for course related purposes. The policy on course notes and related printed and internet materials (e.g. published articles, website information) copyrights follows The General Rules Concerning University Organization and Procedure (University of Illinois Board of Trustees, 1998) and can be found at http://www.vpaa.uillinois.edu/policies/ and any other rule mentioned in the materials.

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the as soon as possible. To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me

after class, or make an appointment to see me, or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu. http://www.disability.illinois.edu/.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to *Family Educational Rights and Privacy Act* (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See http://registrar.illinois.edu/ferpa for more information on FERPA.

Emergency Response Recommendations

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency/floorplans/ .

Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with any kind of emergency – like fire, severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.

Run

Leaving the area quickly is the best option if it is safe to do so.

- Take time now to learn the different ways to leave your building.
- Leave personal items behind.
- Assist those who need help, but consider whether doing so puts yourself at risk.
- Alert authorities of the emergency when it is safe to do so.

Hide

When you can't or don't want to run, take shelter indoors.

- Take time now to learn different ways to seek shelter in your building.
- If severe weather is imminent, go to the nearest indoor storm refuge area. If someone is trying to hurt you and you can't evacuate, get to a place
- where you can't be seen, lock or barricade your area, silence your phone, don't make any noise and don't come out until you receive an Illini-Alert indicating it is safe to do so.

Fight

As a last resort, you may need to fight to increase your chances of survival.

- Think about what kind of common items are in your area which you can use to defend yourself.
- Team up with others to fight if the situation allows.
- Mentally prepare yourself – you may be in a fight for your life.

Other resources

- **police.illinois.edu/safe** for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- **emergency.illinois.edu** to sign up for Illini-Alert text messages.
- **Follow the University of Illinois Police Department** on Twitter and Facebook to get regular