**IB 364 / Genomics and Human Health**

Spring 2017
**Class location:** Gregory Hall 311
**Class times:** Tuesday and Thursday: 9:30-10:50 am
**Instructor:** Dr. Allison K. Hansen
**e-mail:** akh@illinois.edu

**Course outline:**

This course will introduce students to the field of genomics and bioinformatics. Throughout the course a general overview of historical and cutting- edge sequencing and computational technologies will be explored. Emphasis will be placed on the human genome; however unicellular and other metazoan genomes also will be examined at the structural and functional level. This course is designed to acquaint students with critical thinking, problem-solving approaches, and techniques, to better understand the genomic basis of eukaryotic phenotypes, including human disease. Students will achieve this multifaceted molecular genetic understanding of animal biology and disease by utilizing multiple genomic and bioinformatics approaches in an integrative and comprehensive framework.

**Prerequisites:** IB 204-Genetics is required for this course; prior experience in bioinformatics and computer programming languages is not required. This class will not extensively cover advanced computational techniques, or computer programming languages, such as Unix, Perl, or Python.

**Lecture/ in-class exercises and discussions**

This course will be composed of short lectures interspersed with active discussions, and in-class computational exercises, that collectively reinforce lecture concepts and critical thinking skills using a project-based learning approach. Assigned homework and supplementary readings will be read and conducted before coming to class, because it will support course lectures, in-class exercises, and discussions (see Moodle for the class schedule of required reading and important links).

**In-class exams**

A midterm and a non-cumulative final exam, each worth 20% of the total grade, will be given on key concepts learned from lecture material. Students with a valid excuse for missing an exam will be given an opportunity to take a make-up exam at the discretion of the instructor. Excuses are given only for medical reasons (with a note from McKinley), tragedy in your immediate family, or religious observances and practices. The make-up exam will differ in format, content, and length from the original exam.

**In-class exercises and discussion**

In-class computational exercises are worth 10% of the total class grade, and will be conducted with on-line bioinformatics tools and websites. Therefore a personal laptop computer that can connect to wifi will be needed for class. Some in-class computational questions will be derived from the required textbook. Supplemental reading and homework assignments may be required before class for in-class computational exercises (see Moodle). Students with a valid excuse for missing a class can recover the missed points for in-class computational exercises by completing alternative computational exercises from the required text. Students should obtain instructor permission to make up the points, and turn in the make-up assignments within one week of the missed class.

In-class discussion questions are worth 10% of the total class grade, and will be based on primary scientific literature or news articles that must be read before class (see Moodle). Students with a valid excuse for missing a class can recover the missed points for in-class discussions by turning in a short (~1 page) overview of the assigned reading that critically highlights the take-home message of the reading. Permission must be obtained from the instructor to make up points, and the assignment must be turned in within one week of the missed class.

**Homework assignments**

Homework assignments are worth 20% of your total grade. Computational homework assignments will be assigned on-line on Moodle on every Friday to help students understand bioinformatic websites and/or concepts before coming to class the following week. The required textbook will be required for some of these homework assignments. The homework assignment will be available to complete on-line on Moodle from Friday until 9:30am on Tuesday. If you have technical issues accessing the homework on Moodle please send the instructor a screen shot of the webpage, and detail on the issue before the homework due date. Missed homework assignments cannot be made up. Excuses are given only for medical reasons (with a note from McKinley), tragedy in your immediate family, or religious observances and practices.

**Team project- Comprehensive genomic analysis of a human disease**

Teams will be established early in the course, and each group will pick one human disease of interest that they will research as a group throughout the course. Students will learn how to work as a team by conducting in-class exercises, and addressing discussion questions within the team each class period. Several in-class exercises that complement lecture material will require computational analyses using sequence/genomic data that is specific to the team's human disease of interest (e.g. how does the disease causing mutation at the DNA level affect protein folding). Team assignments will provide a comprehensive understanding of the network of molecular mechanisms that underlie the human disease of interest. The last three weeks of the course will be devoted to team projects (20% of the grade), which will consist of a 5-page team synthesis of the genomic mechanisms that contribute to the human disease of interest. Also, a 10-minute power-point presentation of the team results will be required. The power-point presentation must be given at a level that is understandable to the general public. i.e. something a grandma can understand.

**Computer Requirement**

Students are required to have a laptop computer for in-class computational assignments in class. If a student cannot bring her/his laptop then he/she must pair up with someone who has a laptop for in-class assignments and discussion. Most of the work in this class will require computer access in and out of class.

**Reading Assignments**

Required text for the course: Practical Bioinformatics by Michael Agostino, Garland Science. 2013, 1st edition. <*buy or rent on-line*>

Students are expected to read the assigned reading material and conduct homework assignments in this text prior to class and be prepared for lecture. Additional reading material in addition to the text will be assigned. See Moodle for the schedule of reading assignments along with corresponding links.

**Grading:**

Midterm Exam- 20%

Final Exam (not cumulative)- 20%

Final team project- 20% (15%- 5- page group synthesis; 5% presentation)

In-class assignments and discussion questions- 20%

Homework assignments- 20%

Grades are assigned based on the % of points accumulated: 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, <60% = F. Minus (- = 90-92, 80-82, etc.) and plus (+ = 88-89, 78-79,etc.) grades will be given within each grade range.

**Important websites:**

1) Course website on Moodle; you should have an account if you are enrolled in this course. If you do not have access please contact the instructor.

**Office Hours:** 1:00pm-2:00pm on Fridays in Morrill Hall 365

**Course Policies**

All students should follow University of Illinois "Code of Policies and Regulations Applying to All Students"
The Code is available online at: http://www.admin.uiuc.edu/policy/code/index.html

Students will receive an “F” on an exam or assignment if they cheat and/or plagiarize. Completing assignments, exams, or in-class exercises for other students is also considered cheating (by both parties).

Use IB364 course materials are for personal use only and should not be distributed (e.g. posted on-line)

## Class Schedule

| | Date | Unit | Readings- required text* | Topic |
|---|---|---|---|---|
| 1 | 17-Jan-17 | | | What are genomes? |
| | 19-Jan-17 | | Chapter 1 | How are genomes sequenced? |
| 2 | 24-Jan-17 | | Chapter 2 | Functional annotation |
| | 26-Jan-17 | | Chapter 4 | Unicellular genomes & Metazoan genomes |
| 3 | 31-Jan-17 | | pdf- gene duplications | Comparative genomics |
| | 2-Feb-17 | | Chapter 6 | Evolution of genomes |
| 4 | 7-Feb-17 | | pdf | Genomics of organelles and symbionts |
| | 9-Feb-17 | | video link | Human microbiome and microbial diversity |
| 5 | 14-Feb-17 | | pdf | Genomic Identification & Genetic variation-SNPs |
| | 16-Feb-17 | | audio link | Team project exercises and planning session |
| 6 | 21-Feb-17 | | pdf | Cancer genomics |
| | 23-Feb-17 | | pdfs | The human genome and medicine |
| 7 | 28-Feb-17 | **Exam 1** | | |
| | 2-Mar-17 | | Chapter 9 web links | Central Dogma of molecular biology and its exceptions |
| 8 | 7-Mar-17 | | Chapter 7 | Computational tools for the molecular laboratory |
| | 9-Mar-17 | | pdf | Epigenetics |
| 9 | 14-Mar-17 | | Chapter 10 | Gene expression- transcriptomics |
| | 16-Mar-17 | | Chapter 8, pdf | Gene expression- proteomics |
| 10 | 28-Mar-17 | | pdf | Silencing genomes |
| | 30-Mar-17 | | pdf | Systems biology- introduction |
| 11 | 4-Apr-17 | | pdf | Metabolomics |
| | 6-Apr-17 | | pdf | Regulatory & protein interaction networks |
| 12 | 11-Apr-17 | | pdf | Ethical consequences of genomics |
| | 13-Apr-17 | **Exam 2** | | |
| 13 | 18-Apr-17 | Team project work session | | |
| | 20-Apr-17 | Team project work session | | |
| 14 | 25-Apr-17 | Team project work session | | |
| | 27-Apr-17 | **Team project narrative due** | | |
| 15 | 2-May-17 | **Presentations** | | |
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***** Practical Bioinformatics, by Michael Agostino, Garland Science. 2013, 1st edition