

## BIMM 194: GENOMICS, BIG DATA AND HUMAN HEALTH (Winter 2018)

**Instructor:** Dr. Barry J. Grant ( [bjgrant@ucsd.edu](mailto:bjgrant@ucsd.edu) )

**Website:** [https://bioboot.github.io/bimm194\\_W18/](https://bioboot.github.io/bimm194_W18/)

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**Overview:** The Big Data revolution in Biology and health care is here. This upper division 2-unit course reviews how recent advances, particularly in genomics, have the exciting potential to shift medicine from a reactive practice of treating symptoms and diseases, to one where disease risk is diagnosed early or even managed prior to onset.

**Description:** Imagine a world in which you can input your age, lifestyle and genomic information into an App to obtain personalized recommendations for maintaining your health. This might include the food you should eat and not eat, drugs you should take and avoid, and even specific behaviors to adopt. Furthermore, imagine that when you are sick, your doctor inputs the same information, together with your electronic health record, to determine your customized treatment and health management plan. This world is not 30 years in the future but beginning to unfold now.

This course reviews how recent genomic and bioinformatic advances are poised to revolutionize health care. This includes the latest developments in personalized medicine (a.k.a. precision medicine), disease screening, targeted immunotherapy based cancer treatments, pharmacogenomics, and how microbiome and epigenetic factors impact health.

**Audience & prerequisites:** Biology majors with upper division standing. A familiarity with basic biomedical concepts is essential (students should have successfully completed Molecular Biology (BIMM 100)).

**Schedule:** Class will meet once a week from 2-3:20pm on Fridays of the Winter term in York Hall Rm. 3010.

**Class announcements:** All announcements regarding the course will be by email to your UCSD address.

**Office hours & location:** TBD – For now email me for a time and we will make it happen.

**Textbook:** There is no textbook for the course. Lecture notes, homework assignments, and required reading material will be made available from our public facing [course website](#).

## **Class outline:**

### *Week 1*

01/12/18

#### Course introduction & review of genome fundamentals

Introduction to the course, Overview of major learning objectives and topic areas. Human genome review: What is DNA? What is a genome? What does the genome do? How do genomes differ between individuals? How is the genome decoded? Exploring what genetic errors are and what causes them.

### *Week 2*

01/19/18

#### Genomics and cancer treatment

What is cancer and how does it arise? Example genes implicated in cancer. What has been learned from genome sequencing of cancer? How can sequencing advance cancer treatment? Why do some anticancer drugs fail and how might genomic approaches help address the issue? Can genomic approaches help detect early cancer and monitor treatment effectiveness? What is immunotherapy? Can genomics be used to harness a patient's own immune system to fight cancer?

### *Week 3*

01/26/18

#### Recent advances in genomic technologies and their clinical applications

How are genomic technologies currently impacting the practice of medicine? What recent and future advances in genomic technologies have the potential for major clinical impact? What other 'omes' are useful for medicine? Can the transcriptome, proteome and metabolome be useful? How deeply can a person be analyzed? The promise and hype of personalized medicine. Open discussion of how genomics can inform on disease risks and some of the challenges associated with the use and management of genomic and related health information. We will also learn about the 100,000 Genome project and where genomic medicine could take us next.

### *Week 4*

02/02/18

#### How to read a scientific paper & Introduction to student presentation assignments

A guide for selecting, reading and understanding peer-reviewed primary research articles, How to obtain a basic understanding of a published science paper and decide whether or not it is a reputable study? How does the described work contribute to advancing the scientific knowledge base or our technical capabilities? Introduction to student presentation assignments.

### *Weeks 5 to 8*

02/09/18 to 03/02/18

#### Student group literature presentations

Each week 2 student groups of 4 students each will present selected primary literature on recent genomic advances of relevance to biomedical science and health care. Topics may be selected from the following list:

- How useful are genomic approaches to solving mystery genetic diseases?
- How can your genome directly help guide drug treatments for treating disease?
- Can genetic testing be used to predict sports performance and injuries?
- Can genetic testing and genome editing be useful for choosing healthier embryos and producing designer babies?
- How will increased understating of epigenetics impact health care?
- How does the microbiome affect health and can it be rationally altered to improve health?
- Can people be identified solely from their genome sequence and if so what are the implications?
- Will having my genome sequenced affect my family members?
- Who has the right to know your genetic test results?

### *Week 9*

03/09/18

#### Ethics and the communication of genomic and related health information

Key ethical and communication principles relating to genomics, Can your genetic information be used against you? Who controls your genomic and other health information? What is the role of the physician and what are the implications of direct-to-consumer genomic testing? What are the major risks that must be considered when using genomic data? We also consider the issues surrounding the use of genetic information prenatally (e.g. in sperm banks).

### *Week 10*

03/16/18

#### Ethics and course review

Open discussion; Course review; Course wrap up and course evaluation completion.

### **Course objectives:**

At the end of this course students will be able to:

- Describe human genome structure and how genomes differ between individuals.
- Appreciate and be able to describe in general terms the recent rapid advances in sequencing technologies and understand the process by which genomes are currently sequenced.
- Develop an understanding of how genomics can inform us about disease risks.
- Critically evaluate and summarize primary research literature in the genomics area.
- Discuss major ethical, legal and social implications of advances in genomic technologies.
- Utilize terminology such as gene, genotype, phenotype, variant, variants of unknown significance, traits, multifactorial disease, SNP, genetic test, pharmacogenomics, epigenetics, microbiome, whole genome sequencing and exome sequencing.

**Grading:**

Letter grades (F through A+) will be assigned on the basis of student presentations (50 points), homework and in-class quiz assignments (25 points), contributions to class discussion (15 points), and attendance (10 points). Further details will be given in class.

Note, there is no final exam or mid-term for this course.

**Ethics code:**

You are encouraged to collaborate with your fellow students. However, all material submitted to the instructor must be your own work.

*“Academic Integrity is expected of everyone at UC San Diego. This means that you must be honest, fair, responsible, respectful, and trustworthy in all of your actions. Lying, cheating or any other forms of dishonesty will not be tolerated because they undermine learning and the University’s ability to certify students’ knowledge and abilities. Thus, any attempt to get, or help another get, a grade by cheating, lying or dishonesty will be reported to the Academic Integrity Office and will result sanctions.*

*Sanctions can include an F in this class and suspension or dismissal from the University. So, think carefully before you act. Before you act, ask yourself the following questions: a) is my action honest, fair, respectful, responsible & trustworthy and, b) is my action authorized by the instructor? If you are unsure, don’t ask a friend—ask your instructor, instructional assistant, or the Academic Integrity Office”.*

You can learn more about academic integrity at [academicintegrity.ucsd.edu](http://academicintegrity.ucsd.edu)  
(Source: UCSD Academic Integrity Office, 2017)