UCLA UNDERGRADUATE BIOINFORMATICS MINOR

INFORMATION SESSION
RESEARCH REVIEW
SPRING 2016
Bioinformatics is an important interdisciplinary research area with tremendous graduate training and industry opportunities.

Strong and growing group of faculty engaged in active research.

Numerous existing course offerings available at UCLA.

The Bioinformatics Program at UCLA has many components.

- Bioinformatics Interdepartmental Ph.D. Program
- Bioinformatics Undergraduate Minor
- Bioinformatics Seminar Series
- Bioinformatics Undergraduate Research Program
- Bruins in Genomics Undergraduate Summer Research Program
- Computational Genomics Summer Institute
Research Infrastructure for Bioinformatics

- **Quantitative and Computational Biology Institute**
  - Led by Alex Hoffmann
  - Hosts Weekly Seminar Series in Bioinformatics
  - Organizes Summer Undergraduate Research Program in Bioinformatics
  - 6 ½ FTEs and made offer to Gunnar Ratsch last year.

- **Computational Genomics Summer Institute**
  - Joint with IPAM and funded by NIH (PI Eleazar Eskin)
  - Will bring top researchers (~30) in Bioinformatics to UCLA each summer for 1 month for 5 years.

- **Hoffman2 Cluster**

- **Precision Medicine Institute (newly announced)**
Bioinformatics Minor @ UCLA

- Bioinformatics is an important interdisciplinary research area with tremendous graduate training and industry opportunities.
- Strong and growing group of faculty engaged in active research.
- Numerous existing course offerings available at UCLA.

- This Minor organizes available courses into a coherent undergraduate academic program.
  - Graduating students will be positioned to apply to graduate programs in Bioinformatics.
  - Graduating students will be positioned to enter biotechnology industry.
Undergraduate Minor in Bioinformatics

- Housed in the Computer Science department
  - Eleazar Eskin director
  - Advising provided by Engineering School.
  - Was approved by multiple departments in life sciences.
- 8 course minor. Students in any major take 8 courses in Biology + CS + Statistics + Bioinformatics to obtain Minor
- Started in 2013
  - Graduated 13 students and currently has 19 students.
  - Wide range of departments.
Bioinformatics Minor Structure

- 8 course minor (5 upper division, 3 lower division)

  **Computational Biology Seminar Course**
  1. “Introduction to Computational Systems Biology”
     - CS 184 taught by Joe Distefano (lectures by many Bioinformatics faculty)

  2 Core bioinformatics courses from:
  2. “Introduction to Bioinformatics” (Fall)
     - Chem 160A, CS 121 taught by Chris Lee
  3. “Algorithms in Bioinformatics and System Biology” (Winter)
     - Chem 160B, CS 122 taught by Eleazar Eskin
  4. “Computational Genetics” (Spring)
     - CS 124, Human Genetics 124 taught by Eleazar Eskin

- Additional required course
  5. “Algorithms”
     - CS 180 or Math 182

- Remaining upper division courses is elective
- Additional lower division courses are prerequisites
- Minimum of 20 additional units
Three required courses are prerequisites for upper division courses

1. Advanced Programming
   - PIC 10C or CS 32
2. Linear Algebra and Applications
   - Math 33A
3. Introduction to Molecular Biology
   - Life Sciences 3
Bioinformatics Upper Division Electives

- Statistics 100A, 100B - Introduction to Mathematical Statistics OR Biostatistics 110A, 110B - Introduction to Biostatistics
- Computer Science 170A - Mathematical Modeling and Methods for Computer Science
- Electrical Engineering 102 - Systems and Signals
- Electrical Engineering 141 - Principles of Feedback Control
- Computer Science 122 - Algorithms in Bioinformatics and Systems Biology
- Computational and Systems Biology 186 - Computational Systems Biology: Modeling and Simulation of Biological Systems
- Human Genetics 144 - Genomic Technologies
- Ecology and Evolution 135 – Population Genetics
- Molecular Cellular and Developmental Biology 172 - Genomics and Bioinformatics
- Physiological Sciences 125 - Molecular Systems Biology
- Molecular Cellular and Developmental Biology 144 - Molecular Biology OR Microbiology Immunology and Molecular Genetics 132 - Cell Biology of Nucleus OR Chemistry or Biochemistry 153B - Biochemistry: DNA, RNA, and Protein Synthesis
Gateway Course

- Students are required to take 2 unit CS 184 “Introduction to Computational Systems Biology”
  - Seminars by faculty in computational biology (including many Bioinformatics faculty)
- Students encouraged to take seminar course as early as possible.
- Gateway course will be shared with other quantitative biology minors currently being proposed to build undergrad computational biology community.
Research Opportunities

- Minor courses can be part of Major program giving additional electives to complete Minor.

- Research can help complete minor:
  - 8 units of research is available as part of Minor.
  - with 2 additional units from CM 184 leaves only 10 units required to complete Minor.

- Undergraduate Research Program hosts:
  - [http://www.bioinformatics.ucla.edu/undergraduate-research/](http://www.bioinformatics.ucla.edu/undergraduate-research/)
  - Many available projects by Bioinformatics Faculty
  - Leads to a few Bioinformatics Ph.D. students each year.
Administrative Structure

- Minor hosted in Computer Science Department
- Departmental Committee:
  - Eleazar Eskin (Chair)
- Advising performed by HSSEAS Advisors and CS Department
Undergrad Minor Status

- Enrollments very high:
  - 2015 Computational Genetics: 81 undergrad
  - 2014 Computational Genetics: 72 undergrad
  - 2013 Computational Genetics: 68 undergrad
  - 2012 Computational Genetics: 73 undergrad

- Minor officially started in Fall 2012

- Number of Minors hard to track
  - students declare minor immediately before graduation.
  - 10-15 per year based on courses (many different Majors)
  - Another 10-15 “Minorish” students per year.
Curricular Changes

- CS Department made curricular changes to support the Minor
  - Students can get credit for Chem 20A, 20B, 30A, Life Science 2,3,4 and other Life Science courses
  - This allows CS Majors to complete Bioinformatics minor with only 20 additional units.
  - Life Science departments should also make changes allowing:
    - Programming courses as electives
    - Statistics 100A as an elective
    - Bioinformatics courses as electives
    - Possibly replace current required courses with above.
Course Plan: Computer Science Major

- Courses part of Major required courses:
  - CS 32, Math 33A, CS 180.
- Students will take as Engineering GE:
  - Chem 20A, Life Sciences 2.
- Students will take Sci-Tech Bio option (part of Major):
- Students will take CS 184 as an introduction to the area.
- Students can take 2 of CS 121, CS 122, and CS 124 as electives for their CS major.
- Students will take additional bioinformatics elective courses to fulfill the minor requirements.

- Students who take the optional Technical Breadth Area in Computational Genomics can take prerequisites and electives in the program:
  - Life Sciences 4, + 2 Bioinformatics electives
Course Plan: Chemistry Major

- Courses part of Major required courses:
  - Math 31A, 31B, Life Sciences 3,23L (for Biochemistry Majors)

- Students will take the following courses as prereqs for the Minor:
  - PIC 10A, PIC 10B

- Students will take the following lower division Minor requirements:

- Students will take Stat 100A, Biostatistics 100A or 110A.

- Students will take Chem 160A and Chem 160B to count for both their Major and Minor.

- Students will take CS 184 as an introduction to the area.

- Students will take the following upper division Minor requirements:
  - Math 182, and CS 124.
Course Plan: Life Sciences (MCDB) Major

- Courses part of Major required courses:
  - Math 31A, 31B, Life Sciences 3, 23L, Life Sciences 4
- Students can take MCDB 172 as elective for their MCDB major.
- Students will take the following courses as prereqs for the Minor:
  - PIC 10A, PIC 10B and Math 32A or Math 61.
- Students will take the following lower division Minor requirements:
  - PIC 10C, Math 33A.
- Students will take CS 184 as an introduction to the area.
- Students will take the following upper division Minor requirements:
  - CS 180 or Math 182, CS 121, CS 124, and one bioinformatics elective.
Courses part of Major required courses:
- Math 31A, 31B, Life Sciences 3, 23L, Life Sciences 4

Students can take MCDB 172 as elective for their MIMG major.

Students will take the following courses as prereqs for the Minor:
- PIC 10A, PIC 10B and Math 32A or Math 61.

Students will take the following lower division Minor requirements:
- PIC 10C, Math 33A.

Students will take CS 184 as an introduction to the area.

Students will take the following upper division Minor requirements:
- CS 180 or Math 182, CS 121, CS 124, and one bioinformatics elective.
Course Plan: Life Sciences (EEB) Major (Biology; Ecology Behavior and Evolution)

- Courses part of Major required courses:
  - Math 31A, 31B, Life Sciences 3,23L, Life Sciences 4
- Students will take the following courses as prereqs for the Minor:
  - PIC 10A, PIC 10B and Math 32A or Math 61.
- Students can take Math 182 as an elective for their Major.
- Students can take one of many courses which both are Bioinformatics electives and Major electives including EEB 135 or MCDB 172.
- Students will take the following lower division Minor requirements:
  - PIC 10C, Math 33A.
- Students will take Stat 100A, Biostatistics 100A or 110A.
- Students will take CS 184 as an introduction to the area.
- Students will take the following upper division Minor requirements:
  - CS 121, and CS 124.
Course Plan: C&SB Major

- Courses part of Major required courses:

- Students will additional Minor electives as part of their Major requirements:
  - Statistics 100B, EE 102 C&SB 186.

- Students who take the bioinformatics concentration will take CS 121, CS 124, and one of MCDB 172 or Phy Sci 125 electives for their C&SB and one bioinformatics elective.
  - These students will take CS 180 and 5 additional bioinformatics elective courses to fulfill the minor requirements.

- Students who take one of the other concentrations will take CS 121, CS 124, CS 180 and 3 additional bioinformatics elective courses.