# UCLA UNDERGRADUATE BIOINFORMATICS MINOR

# INFORMATION SESSION RESEARCH REVIEW SPRING 2016

Info Session and
Research Review
Spring 2016

# Bioinformatics @ 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.

- 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

# Bioinformatics Lower Division Courses

- 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

- Statistcs 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/
  - 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” stundents 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):
  - Chem 20B, Chem 30A, Life Sciences 3.
- 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:
  - PIC 10C, Math 33A, Life Science 3,23L (if not taken for Biochemistry Major).
- 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.

# Course Plan: Life Sciences (MIMG) 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 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:
  - PIC 10C, Math 33A, Life Sciences 3,23L, Statistics 100A, CS 184.
- 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.