# New Course - Fall 2017

# Biomath 205
# The Top Computational Algorithms

**Instructor: Prof. Ken Lange**
**Tuesdays and Thursdays**
**10:00 - 11:50 AM**
**5236 Life Sciences Building**

BIOMATH

**Course Objectives**

a) a brief introduction to Julia programming language, b) appreciation of the history of algorithms, c) facility in algorithm derivation and coding, d) understanding of practical computational complexity, e) hardware constraints and parallelism, f) major themes in algorithm derivation such as Newton's method and randomization, and g) assembling algorithms from building blocks such as BLAS (Basic Linear Algebra Subprograms).

**Course Description**

Most courses on algorithms are narrowly focused on a single field of application. This course is intended as a broad survey that cuts across discipline boundaries. Algorithm derivation is a legitimate branch of the mathematical sciences that is driven by hardware advances and the demands of many scientific fields. The best algorithms are undergirded by beautiful mathematics. Students deserve a chance to look under the hood of a few basic algorithms and understand how they operate. They also should learn how to assemble complex algorithms from simpler building blocks. Julia is an ideal programming language for prototyping and refining algorithms. It has a simple syntax and a variety of tools that students can exploit.

**Weekly topics:**

(a) Ancient algorithms and a brief introduction to Julia (programming language)
(b) Number theory algorithms
(c) Sorting algorithms
(d) Matrix factorization
(e) Newton's method
(f) Linear programming
(g) Eigenvectors and eigenvalues
(h) EM (Expectation–Maximization) and MM (Majorize-Minimization) algorithms
(i) Fast Fourier transform (FFT)
(j) Monte Carlo

**Course assignments:**

Each week students will be given a menu of computing and theoretical exercises from which to choose. A minimum of one exercise per lecture will be required.

**Grading structure:**

Grades will be determined by performance on the homework.

**Reading lists:**

The books *Numerical Analysis for Statisticians*, *Optimization*, and *MM Optimization Algorithms* by the course instructor (Kenneth Lange) are recommended. These will be supplemented by weekly lecture notes.